DECEMBER 1952

Chemical Engineering

15th MATERIALS OF CONSTRUCTION ISSUE

CORROSION:

Fight the battle by updating your know-how and use of:

PROTECTIVE COATINGS

A McGRAW-HILL PUBLICATION

ONE DOLLAR

DECEMBER
1952

Chemical Engineering

WITH CHEMICAL & METALLURGICAL ENGINEERING

15th MATERIALS OF CONSTRUCTION REPORT

ENGINEERING AND EQUIPMENT

PROCESSES AND PRODUCTS

NEWS AND TRENDS

PEOPLE AND FIRMS

LITERATURE AIDS

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Member ABC and ABP

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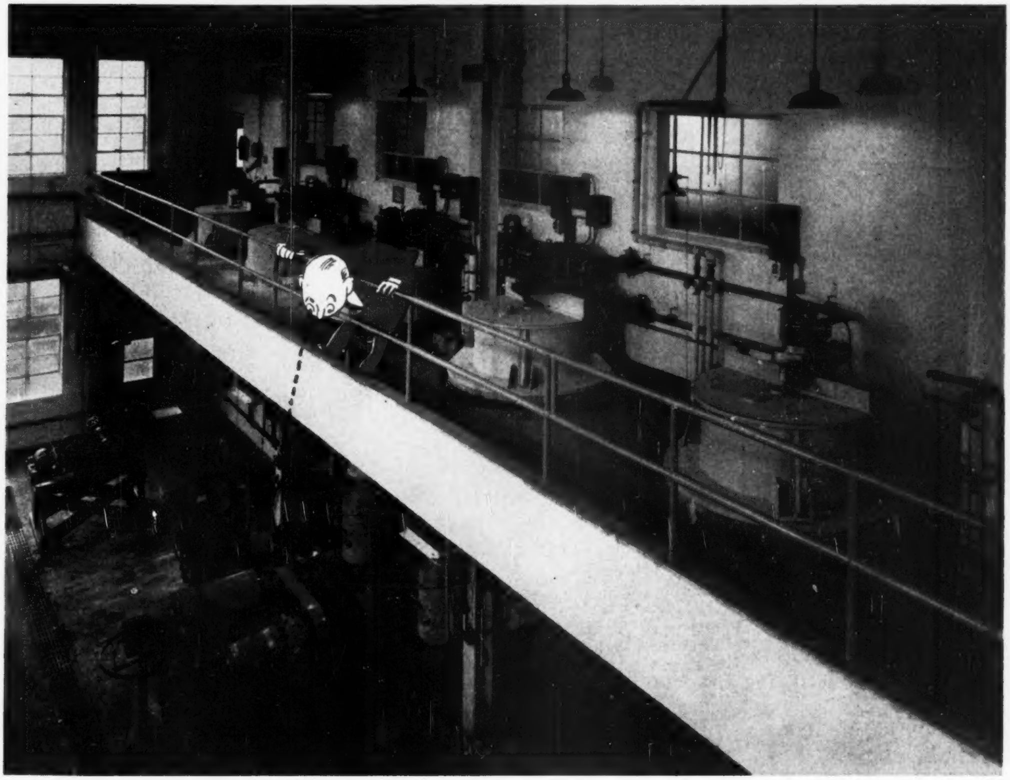
This man has information

1000

PUT YOURSELF IN HIS PLACE

to be *sure* of the right answers on your particular *filtering* operation



The Bird Research and Development Center, a portion of which is pictured here, is set up and staffed for one purpose only — to help you get the right answers *in advance of any investment in filtration equipment* to such questions as these:

how good a separating job can I expect with my kind of feed slurries and my types and sizes of solids?

what capacity per Filter can I expect?

how good a wash can I get?

how much floor space will it take?

what auxiliary equipment, if any, will be needed? (Bird Filters require no filter cloths or media, no vacuum, no auxiliaries)

what will the right Filter cost to buy, install, operate and maintain?

Why not take advantage of the knowledge, experience and facilities concentrated in this Bird Research and Development Center to get whatever filtration facts you need. Test findings will be unbiased because Bird builds such a wide range of filtration equipment.

BIRD MACHINE CO.
South Walpole
Massachusetts

Builders of the Bird Continuous Solid Bowl Centrifugal Filter • the Bird Screen Type Centrifugal Filter • the Bird Centrifugal Classifier • the Bird Suspended Batch Type Centrifugal • the Bird-Young Continuous Vacuum Filter.

RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER

Where B.F.Goodrich grommet belts have outlasted others 8 to 1

B. F. Goodrich grommet V belts cut costs 20 to 50%

EACH time this machine is started the belts that drive it take a beating. The shock, combined with the heavy pulling load and high speed, caused the first set of V belts used on this drive to fail in only 6 months. Something exceptional was needed, so B. F. Goodrich grommet V belts were installed. That was over 4 years ago, and they're still in use. In fact, the company superintendent says it looks as though this same set of grommet V belts will operate another 10 years. Here's why B. F. Goodrich grommet belts outperform ordinary belts:

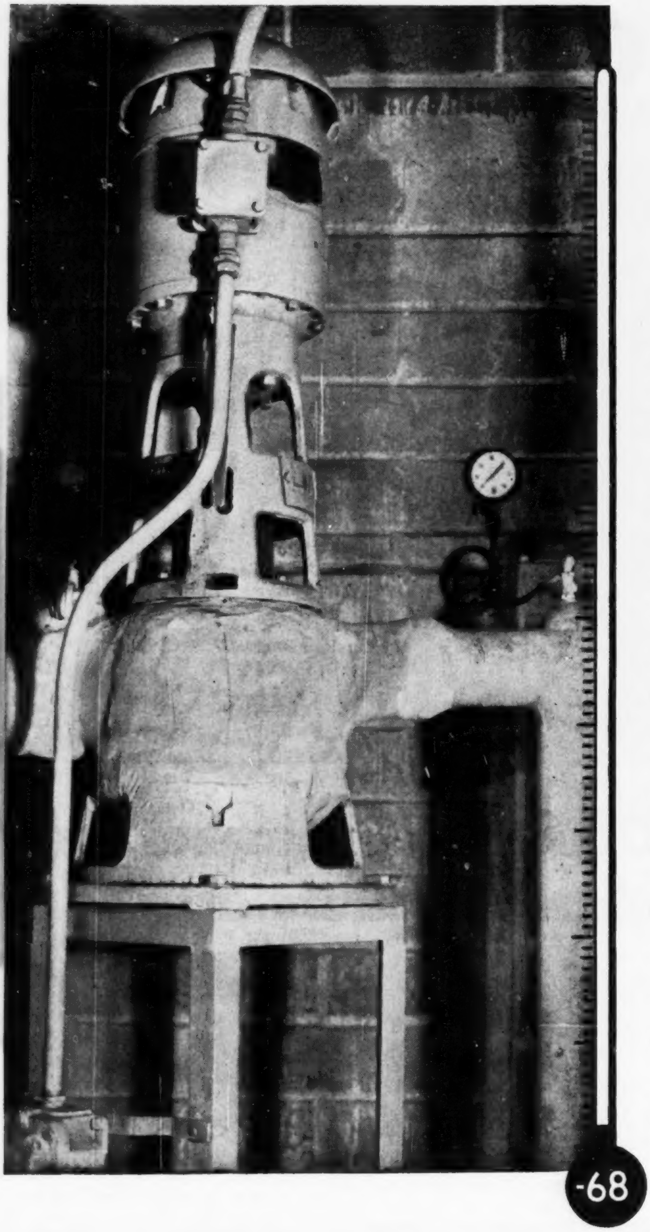
No cord ends — A grommet is endless, made by winding heavy cord on itself to form an endless loop. It has no overlapping ends. Because most of the failures in ordinary V belts occur in the region where cords overlap, the endless cord section in a grommet V belt eliminates such failures.

Concentrated cord strength — All of the cord material in a B. F. Goodrich grommet belt is *concentrated* in twin grommets, positioned close to the driving faces of the pulley. There are no layers of cords to rub against one another and generate heat; cord and adhesion failures are reduced. And grommet V belts stretch less — only ⅓ as much, on an average, as ordinary V belts.

Better grip, less slip — Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip pulleys better. Size for size, grommet belts give ⅓ more gripping power, pull heavier loads with a higher safety factor. Because there is less slip, there is also less surface wear.

They cost no more — Grommet V belts cut costs because they last longer, increase production because machines keep running with fewer interruptions, reduce maintenance costs because they need less attention, yet they cost not one cent more. Available in C, D, and E sections. But remember, only B. F. Goodrich makes the grommet V belt (U. S. Patent No. 2,233,294), so to get all these savings, call in your local BFG distributor the next time you need V belts, or write *The B. F. Goodrich Company, Industrial & General Products Division, Akron, Ohio.* (Available in Canada)

Grommet V-Belts BY
B.F. Goodrich
RUBBER FOR INDUSTRY


-68

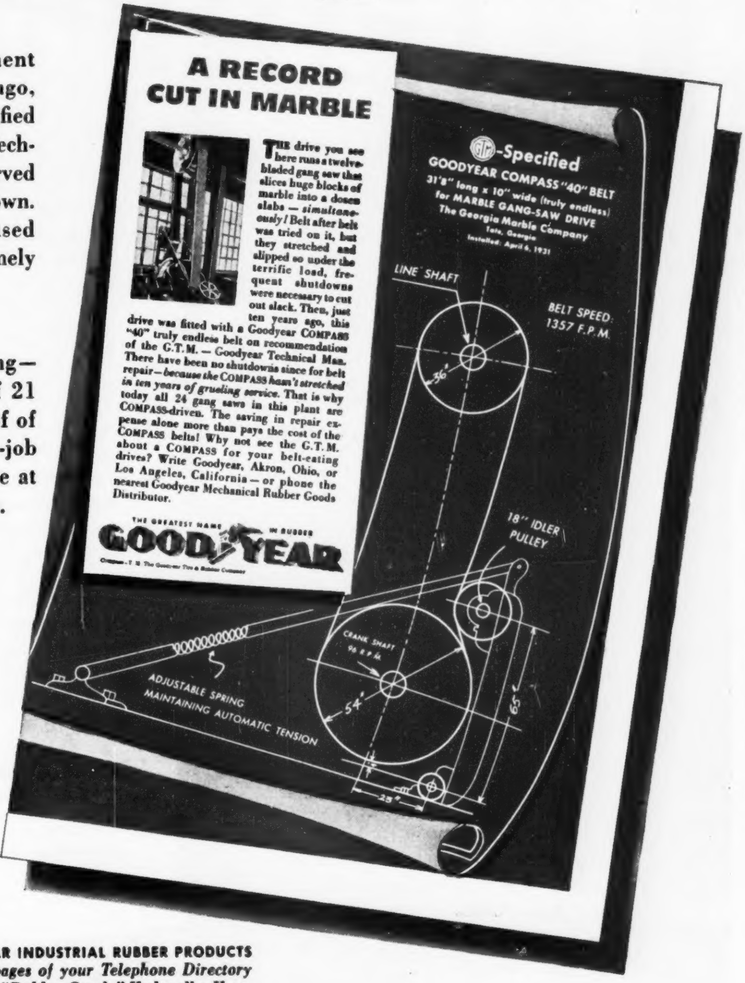
Looking For Long Belt Life?

THIS STORY SHOULD SHOW YOU THE ANSWER!

WHEN this advertisement appeared 11 years ago, the COMPASS 40 Belt specified by the G.T.M.—Goodyear Technical Man—had already served 10 years without a shut-down. Earlier belts had all caused trouble due to the extremely heavy drive.

TODAY

—this belt is still running—for a total life so far of 21 years and 7 months—proof of Goodyear's design-for-the-job that means longest service at lowest cost in the long run.



LOOK FOR YOUR GOODYEAR INDUSTRIAL RUBBER PRODUCTS DISTRIBUTOR *in the yellow pages of your Telephone Directory under "Rubber Products" or "Rubber Goods." He handles Hose, Flat Belts, V-Belts, Molded Goods, Packing, Tank Lining, Rubber-Covered Rolls built to the world's highest standard of quality.*

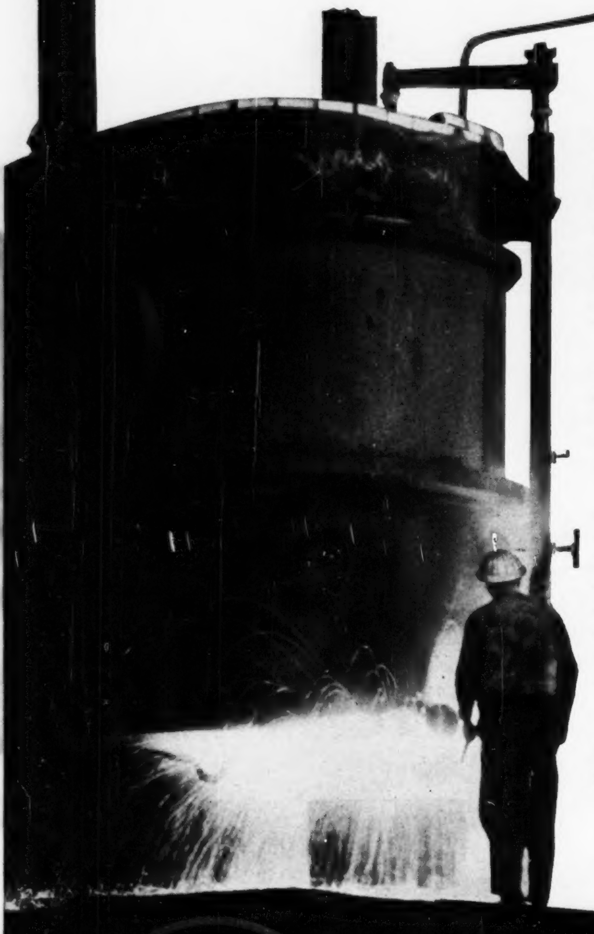
GOODYEAR

THE GREATEST NAME IN RUBBER

We think you'll like "THE GREATEST STORY EVER TOLD"—Every Sunday—ABC Network

Compass—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

PRECISION PERFORMANCE of PRESSURE VESSELS STARTS HERE



Precision controlled quality starts in Midvale pressure vessels when the molten steel pours from the giant ladles in Midvale's open hearths. From then until the final machining operation skilled hands build unsurpassed performance into equipment for the petroleum, chemical and other processing industries.

Midvale's experienced craftsmen and engineers are equally skilled in producing the finest in small vessels to withstand low pressures . . . or large forged steel vessels to stand pressures up to 9000 pounds per square inch.

For precision produced forged pressure vessels, heat and corrosion resistant castings, tube supports and hangers to your most exacting specifications let Midvale make them. Our engineers are ready to help you design them . . . our experienced men working with the most modern equipment can produce them.

THE MIDVALE COMPANY
NICETOWN • PHILADELPHIA 40, PENNA.

Offices: New York, Chicago, Pittsburgh
Washington, Cleveland, San Francisco

MIDVALE

Custom Steel Makers to Industry

PRODUCERS OF FORGINGS, ROLLS, RINGS, CORROSION AND HEAT RESISTING CASTINGS

NOW, FOR THE **PROCESSING INDUSTRIES . . .**

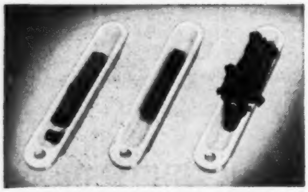
a brand-new Carboloy created-metal equipment parts against corrosion,

GET THESE FREE CHROME CARBIDE DATA SHEETS

Now, at no cost to you, well-illustrated Technical Bulletin WR-104, containing data sheets that include: physical properties, characteristics of Grade 608 Chrome Carbide, many test results, chemical comparisons between both chrome carbide and steel, plus machining and brazing methods, application histories, etc. Send coupon, opposite page, for your free copy.

See how chrome carbide

✓ WITHSTANDS GREAT HEAT

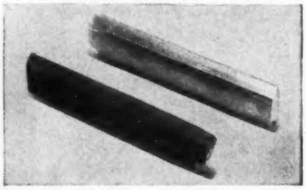


After exposure in air at 1850° F. for 24 hours, Grade 608 Chrome Carbide (center) is hardly discolored, while 18-8 stainless steel (left), tungsten carbide (right) are all but disintegrated. Bars originally were same size, shape.

✓ RESISTS CORROSIVE ACIDS AND ALKALIS

With sulphuric acid as the corrosive agent, for example, chrome carbide parts, such as those above, show about 30 times the resistance of 18-8 stainless steel and 3 times the resistance of tungsten carbide.

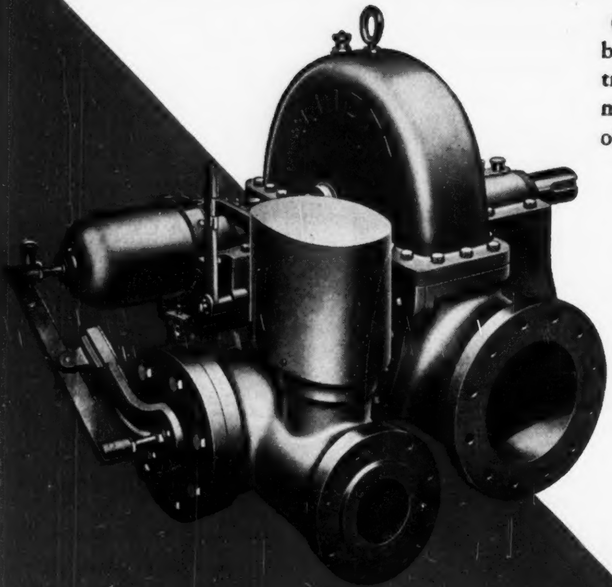
✓ STOPS ABRASIVE WEAR COMBINED WITH CORROSION OR EROSION



Centrifuge blades, after 6 weeks of operation under severe conditions. Tungsten blade (left) shows wear. Chrome carbide blade (right) successfully resists the combination of abrasion, corrosion and erosion.

Both strong in ELLI

YR Turbines



YR Turbines are built on a production basis, but engineered to allow an extremely wide range of modifications to meet specific conditions. Here are some of them:

- **Five frame sizes —**
- **Eight different turbine types —**
- **Your choice of several governors each independent of the standard overspeed governor —**
- **Six elective control devices, including:**

1. Two hand valves controlling nozzling
2. Hand-operated speed changer
3. Remote control speed changer, air or electric
4. High exhaust pressure trip
5. Remote control electrical trip
6. Hand throttled emergency trip valve.

- **Gland seal piping for condensing operation, or operation with gas —**
- **Exhaust connection on either side.**

This turbine makes friends everywhere, in all industries, for its tailor-made adaptability, its simplicity, its extremely reliable performance, its surprisingly low maintenance—all qualities of highest value. Capacities to 2000 hp. Speeds, 800-7000 rpm.

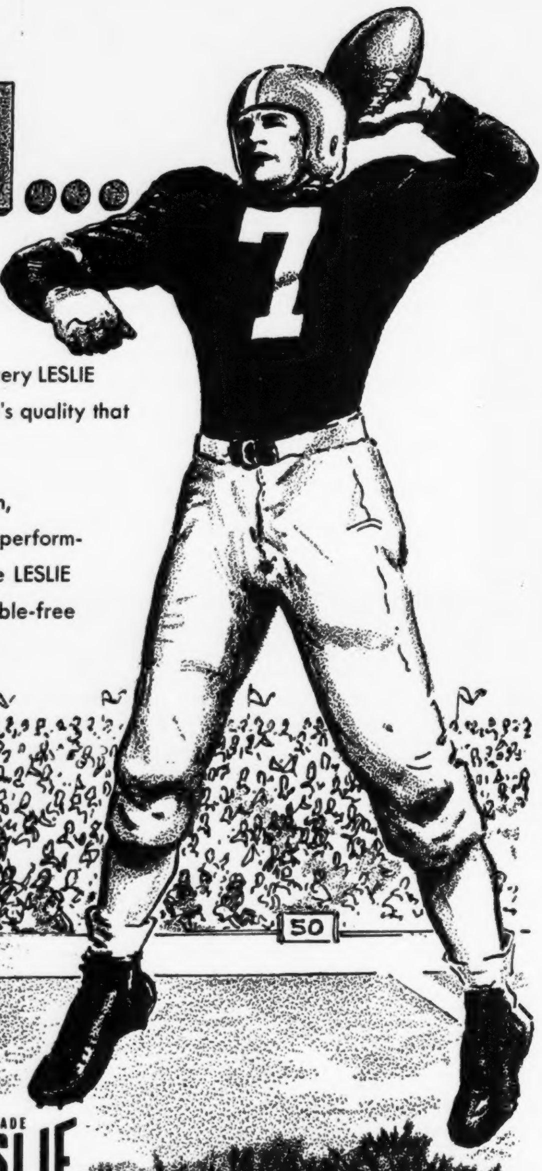
ELLIOTT

STEAM TURBINE DEPT. • JEANNETTE, PA.

Plants at: JEANNETTE, PA. • RIDGWAY, PA.

DISTRICT OFFICES IN

Dependable Control...



The same unerring control
that directs a pass into the waiting arms of a speeding end is a "built-in" advantage of every LESLIE Regulator. In automatic controls, as in sports, it's quality that makes the difference.

The fundamental principles of quality design, quality materials, quality manufacture, quality performance and quality service all combine to make LESLIE a logical choice for long-lasting, accurate, trouble-free pressure, temperature, or liquid level control.

Class L-3
Pressure Reducing Valve

TRADE
LESLIE
MARK

PRESSURE REDUCING VALVES —For Steam, Air or Gas.
PUMP GOVERNORS —For pump discharge pressures.
DIAPHRAGM CONTROL VALVES —For use with instrument controllers.
TEMPERATURE REGULATORS —For process heating or cooling.
CONTROL PILOTS —For pressure, temperature, and level control.

SELF-CLEANING STRAINERS • AIR HORNS • STEAM WHISTLES

Write for illustrated bulletin on type of regulator desired. 1708

LESLIE CO. 235 Grant Avenue, Lyndhurst, New Jersey

QUALITY REGULATORS FOR OVER HALF A CENTURY

have been added CROUSE-HINDS Type EPC motor starter and circuit breaker CONDULET *

You get all of them on the Model M52

Model M52 EPC is the most flexible explosion-proof line starter and circuit breaker enclosure ever produced. The addition of 7 new features to the proven basic advantages of the EPC construction assures the greatest ease of installation and maintenance.

The exclusive basic advantages of the EPC Condulet have made it the world's leading enclosure for housing motor starters, circuit breakers and combinations for use in hazardous locations.

The basic advantages are:

EASY INSTALLATION . . . The use of a strong light-weight aluminum alloy and the unique three-section design makes it practical for an electrician and his helper to install the largest housing without the use of costly lifting equipment. The internal devices can be easily removed for pulling in the wires.

THREADED JOINT CONSTRUCTION . . . All joints are threaded. All operating shafts and bushings are thread-in-thread construction. This insures maximum safety, easy inspection and maintenance, and maximum corrosion protection.

FLEXIBILITY . . . A large number of different enclosures can be assembled from the wide variety of sizes of bodies and covers. They are not only used for circuit breakers and starters but have proven adaptable for many other types of electrical equipment. The body has numerous conduit hubs for flexibility of installation.

COST AND TIME SAVINGS . . . The outstanding advantages of the unique EPC Condulet over conventional explosion-proof enclosures all add up to lower installed cost and lower maintenance cost.

All of these advantages have been available for years.

Now Crouse-Hinds offers you 7 new improvements to underline the basic advantages of type EPC Condulets and to save you more dollars and more man-hours than ever before.

1. **Built-in Push button stations** available on line starters and combinations of line starters with circuit breakers — START — STOP, FOR — REV — STOP and HIGH — LOW — STOP stations for regular, reversing, or two-speed starters.
2. **Built-in selector switch** is available on line starters and combinations of line starters with circuit breakers. Normally supplied marked HAND — OFF — AUTO or JOG — RUN — OFF, three-position style. Two-position selector switch or combinations of selector switch with START — STOP station can be supplied.
3. **Back conduit entrance** can be supplied by drilling and tapping the boss in the center of the back . . . in addition to the four regular top and bottom hubs.
4. **Protective Neoprene gasket** is available for the upper cover joint. Where EPC Condulets are exposed to unusually severe weather or corrosive conditions, this gasket provides additional protection.
5. **A new RESET lever with threaded shaft,** rotating within a threaded bushing, provides easier and more positive operation of the reset mechanism.
6. **Horizontal through-feed conduit entrances** are provided by drilling and tapping bosses on the sides of the Condulet body.
7. **Greater ease in wiring** is provided by increased height in the center body section and by universal use of open framework mountings for circuit breakers and starters in the new model M52 EPC Condulets.

Model M52
Type EPC Explosion-Proof Condulet in 7, 9, and 11-inch body sizes

Send for YOUR copy of Bulletin 2634

*CONDULET is a coined word registered in the U.S. Patent Office. It designates a product made only by the Crouse-Hinds Company.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

OFFICES: Albuquerque — Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York — Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle — St. Louis — Tulsa — Washington. RESIDENT REPRESENTATIVES: Albany — Atlanta — Baltimore — Charlotte — New Orleans — Richmond, Va.
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

AIRPORT LIGHTING • FLOODLIGHTS

TANK — Self-supporting tank gains rigidity from external reinforcement strips. Ideal for metal processing vats and for storage of corrosive liquids. Illustration shows tank seams being welded; welded seams are completely [illegible], stronger than the material itself.

DRUM OR TANK BASE — for storage or handling of corrosive liquids. Sheet Boltaron 6200 is malleable when hot (300°F) may be formed with simple low-pressure plug and ring set-up shown. Formed sheet is trimmed with band-saw and welded to main tank assembly.

SEAMLESS PIPES — Light-weight, corrosion-proof, can be bent, welded, threaded, flared, flanged, etc. Withstand considerable pressure both internally and externally.

PRESSURE-TYPE JET NOZZLE — Made of cut and formed sheets, built-up pipe and special stampings, welded together into one unit. Typical example of the way Kortwell can help translate your designs into working parts.

IT'S *Boltaron* 6200

 Prepared by U. S. Industrial Chemicals Co.

U.S.I. CHEMICAL NEWS

★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★

New Technique Detects, Measures Sulfur Dioxide

A new technique, similar to the widely used carbon monoxide-sensitive gel method, has been developed for detecting and measuring small concentrations of sulfur dioxide, according to a recent report. The method depends upon color changes which occur when granules of a chemically treated silica gel are exposed to the gas. The gel granules are placed in a glass tube, approximately the size of a cigarette, and the air sample is drawn through the tube. Any sulfur dioxide present is absorbed, and reacts almost instantly to cause a permanent, non-reversible color change.

Quantitative measurements can be made by matching the color with standard color cards, measuring the length of the colored portion, or by measuring the volume of sample necessary to cause a certain color change or standard length of discoloration. The best sensitivity obtained so far is approximately 5 ppm for a 150 ml. sample, it is said. Other acidic gases may interfere to some extent, but the colors produced are not the same as those caused by sulfur dioxide. Carbon monoxide does not cause a color change, and variations in temperature and humidity seem to have no effect, according to the report.

Fluoroethylene Polymers Reviewed in Govt. Report

Results of a series of investigations into the nature of monochlorotrifluoroethylene polymers have been made available in a report issued recently by the government. Emphasis is placed on the fact that the modulus of elasticity of these resins increases only gradually over a wide temperature range. The materials do not shatter readily at temperatures as low as —200° C., and they can resist flow under low to moderate loads at temperatures as high as plus 200° C. In addition, they have outstanding electrical resistivity under conditions of high humidity, high temperatures, and in contact with corrosive chemicals. Accordingly, particular reference is made in the report to the usefulness of the resins in wire coating and molding applications for electrical insulation, and fabrication methods are discussed in detail.

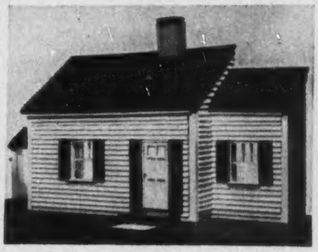
New Peroxygen Bulletin

Various ways of using peroxygen compounds advantageously in the treatment of metal surfaces are outlined in a new bulletin recently issued by a manufacturer. Hydrogen peroxide, persulfates, and peracids, the principal compounds described, have found use in treatments to improve adherence of finishes to metal surfaces, to improve the appearance of metal surfaces by applying chemically produced surface films, and to facilitate plating operations. Procedures covering these uses are given, and various examples are cited.

U.S.I. Exhibiting Products Manufactured for Paint Industry At Annual Industries' Show

Exhibit Includes Full Line of Natural and Synthetic Resins, Industrial Alcohol, Solvents; Model House Illustrates Use of U.S.I. Specialized Resins

The U. S. Industrial Chemicals Co., Division of National Distillers Products Corporation, will exhibit the wide range of products it manufactures for the paint industry at the annual Paint Industries' Show, being held this year at the Palmer House in Chicago, November 18 through 22. Held in conjunction with the annual meeting of the Federation of Paint and Varnish Production Clubs and the annual convention of the National Paint, Varnish, and Lacquer Association, the show brings together the members of the protective coatings industry and the raw materials and equipment manufacturers who supply the industry.



One of the features of U.S.I.'s exhibit is a model house finished inside and out with paints containing various U.S.I. specialized resins.

U.S.I.'s products on display will include industrial alcohol and solvents, natural resins, and synthetic resins. Applications of U.S.I. lacquer solvents and industrial alcohol – including SOLOX for the manufacture and thinning of shellac – will also be shown. Product samples and literature will be available for inspection, and representatives from U.S.I.'s head office will be on hand to answer inquiries.

MORE

Use Metal 'Arm' to Tell How Warm Fabrics Are

A new apparatus which measures the warmth properties of textile fabrics has been developed in the course of research to improve the utilization of cotton, according to a recent report. It is pointed out that while warmth is an important service requirement of many fabrics, it is a difficult property to evaluate, and up to now there has been no generally accepted test. The new apparatus consists of a metal "arm", clothed in a sleeve of the test fabric, which is lowered into a commercial home freezer. A fan in the freezer maintains a wind velocity of 12 to 13 miles an hour over the surface of the fabric. The warmth value of the fabric is rated by determining the difference in energy required to maintain the "arm" at a constant warm temperature in the freezer when uncovered and when covered with the test material. The method is reported to have been useful in testing experimental cotton fabrics for military purposes, and it is expected to find commercial applications.

Re-Usable Concrete Forms Cut Casting Time, Costs

Of interest to plants where construction plans are underway is an idea recently imported from Europe for reducing the time and cost of cast-in-place concrete jobs. The idea involves the use of expansible concrete forms, now being distributed in this country, which can be used many times. Constructed on a special principle that allows adaptation of panel size to a variety of dimensions, the forms consist of wooden struts that are latticed together and hinged at the intersection points. After adjustment on the job site to the required panel dimensions, the form is covered with sisal kraft paper for rough finished work, or with a liner of composition board for a smooth finish. The lining can be quickly tacked into place on the form and stripped off once the concrete has set. The form is then left clean and ready for reuse, according to company spokesmen.

Blood Methionine Level Drops After Severe Wounds

It has been found that the methionine level in the blood drops 30 to 45 per cent from the normal level immediately following surgery or severe burns, according to recent reports. If nourishment is made available, the normal level of methionine in the blood can be restored in about 48 hours. On the basis of these findings, it is thought that the use of methionine in some form following surgery or severe burns has definite possibilities.

★ U.S.I. CHEMICAL NEWS ★

CONTINUED *Paint Show*

Model House on View

One of the principal features of the exhibit will be "The House of U.S.I." – a scale model house designed to illustrate the use of U.S.I. resins in all types of household finishes. The house was first unveiled as one of the features of U.S.I.'s new exhibit at the Paint Industries' Show in Atlantic City last year. This year the house has been expanded to show the interior as well as the exterior, symbolizing the importance of U.S.I. products in interior wall and floor finishes as well as in exterior paints.

U.S.I. conscientiously maintains a policy of developing specialized, tailor-made resins designed to do a specific job better than it has been done before. The model house carries out the spirit of this policy by illustrating the use of various U.S.I. AROPLAZ resins in exterior trim finishes, porch and deck paints, and also in exterior house paints, although the resin used for the latter purpose is not in general distribution as yet. On the interior, such resins as AROFLATS for wall finishes, AROFLINTS for floor finishes, AROCHEMS for floor varnishes and enamels, and AROPLAZ resins for trim and for latex paints, are featured.

New Heart Drug Relieves, Prevents Angina Attacks

Peritrate, a drug made available early this year, is reported to have materially benefited 80 per cent of an experimental group of patients suffering from angina pectoris. A dangerous and common heart ailment, angina pectoris is characterized by severe spasmodic chest pains caused when not enough oxygen reaches the heart muscles. Treatment requires the use of a drug capable of easing constriction of blood vessels responsible for the oxygen supply to the heart, without causing undesirable reactions in the patient. In this latest clinical test, which involved more than 40 patients, the new drug is claimed to have shown evidence that in some cases it can prevent attacks of angina as well as relieve the attacks after they have occurred.

Valve Shield Prevents Injury from Acid Spray

A new flexible valve shield made of synthetic rubber has been introduced for use on valves handling acids and other hazardous chemicals. The shield is said to protect the operator from injury if the valve stem packing should fail by cupping the stem and packing gland, preventing acid from spraying on anyone working near by. Molded in the shape of a flower pot, the shield is installed by cutting a hole in the bottom with a slightly smaller diameter than the valve stem. The valve wheel is then removed and the shield pulled down over the stem so that it covers the packing gland. Flexibility is said to be a major advantage because the valve can be inspected and tightened without removing the shield. It can also be installed while the valve is in service.

New Nylon Powder Can Be Cold Pressed, Sintered

Development of a finely divided nylon powder, produced by a special chemical process which makes it suitable for cold pressing and sintering techniques, was announced recently. Use of the material is similar to methods employed in powder metallurgy, and the powder is said to make possible the production of sintered bearings, gears, etc., which have certain advantages over the similar injection molded items. Bearings thus produced are claimed to have an unusually low coefficient of friction and to be suitable for use without lubrication.

Magnetic Pipeline Traps

A new brochure has been issued on the use of magnetic pipe line traps designed to remove tramp iron from liquid flow lines. Such traps serve to protect processing equipment such as pumps, screens, grinders, fillers, etc. The brochure describes typical magnetic trap installations and includes sections on variables affecting trap size and capacity.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U. S. I.

A new paint roller, designed for all types of paints on all surfaces, features a spring release cover lock which allows rapid removal of the cover for changing and cleaning. **(No. 861)**

A miniature air conditioner, originally used to protect aircraft gun sights from fogging, freezing, and dirt, is now available for civilian applications, such as protection of optical, electronic, and mechanical instruments, business machines, and in storage cabinets for instruments, chemicals, medicines, and foods. **(No. 862)**

Years can be added to the life of concrete floors, it is claimed, with a new "flush-on", quick-acting liquid which prevents breakdown of concrete by sealing, binding, and case-hardening the surface. **(No. 863)**

As a replacement for castor oil, a new, modified, non-drying vegetable oil with similar solubility properties is now available in commercial quantities. The oil is said to have shown promise as a plasticizer for lacquers and coated fabrics. **(No. 864)**

To heat drums of viscous materials to facilitate emptying, a wrap-around drum heater is being marketed. Wattage concentration is claimed to be low enough not to "coke" or burn contents. **(No. 865)**

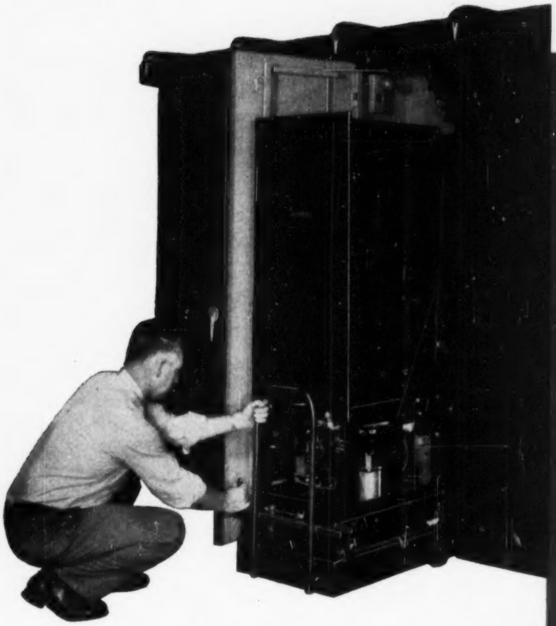
A stirrer, completely powered by air, and designed especially for use with viscous solvents, lacquers, paints, oils, and chemicals, runs at 50 to 1200 r.p.m. on an air supply of 35 to 100 lb./sq. in., according to the manufacturer. **(No. 866)**

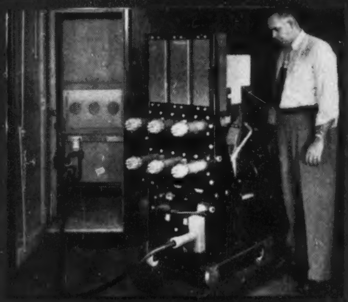
Paint can be removed continuously as fast as the operator can scrape, it is claimed, with a new electric device which employs radiant heat to soften the paint for easy removal with a putty knife. Remover is designed for both home and professional use. **(No. 867)**

A new warmer plate with thermostatic control to within 1° C. is ideal for keeping solutions at desired temperatures, for evaporating them below their boiling points, and as a utility heating plate for temperatures up to 100° C., the manufacturer states. **(No. 868)**

A new mold release solution for plastics, furnished with a rechargeable spray atomizer, dries instantly, is long lasting, and does not carbonize or cause discoloration, it is claimed. **(No. 869)**

A new paint that can withstand temperatures up to 1700° C., consists of copper flakes in a silicone base, dries in 30 minutes, prevents rust, and resists corrosion from mild acids, alkalies, and industrial fumes, according to the manufacturer. **(No. 870)**





Install Switchgear Outdoors

GET CONVENIENT OPERATION PLUS COMPLETE PROTECTION

When building-cost considerations suggest outdoor switchgear installations, you'll naturally want equipment that can be most conveniently operated and maintained in the open . . . and weatherproofed to protect against rust and corrosion. Westinghouse Outdoor Metal-Clad Switchgear meets these specifications.

Convenient Operation and Maintenance—Easily operated horizontal drawout circuit breakers eliminate lifting and lowering. A few turns of a crank connect or disconnect the breaker. Breakers of like rating are interchangeable and are easily rolled on the adjustable-height transport truck with its combination latching device for breaker and stationary structure.

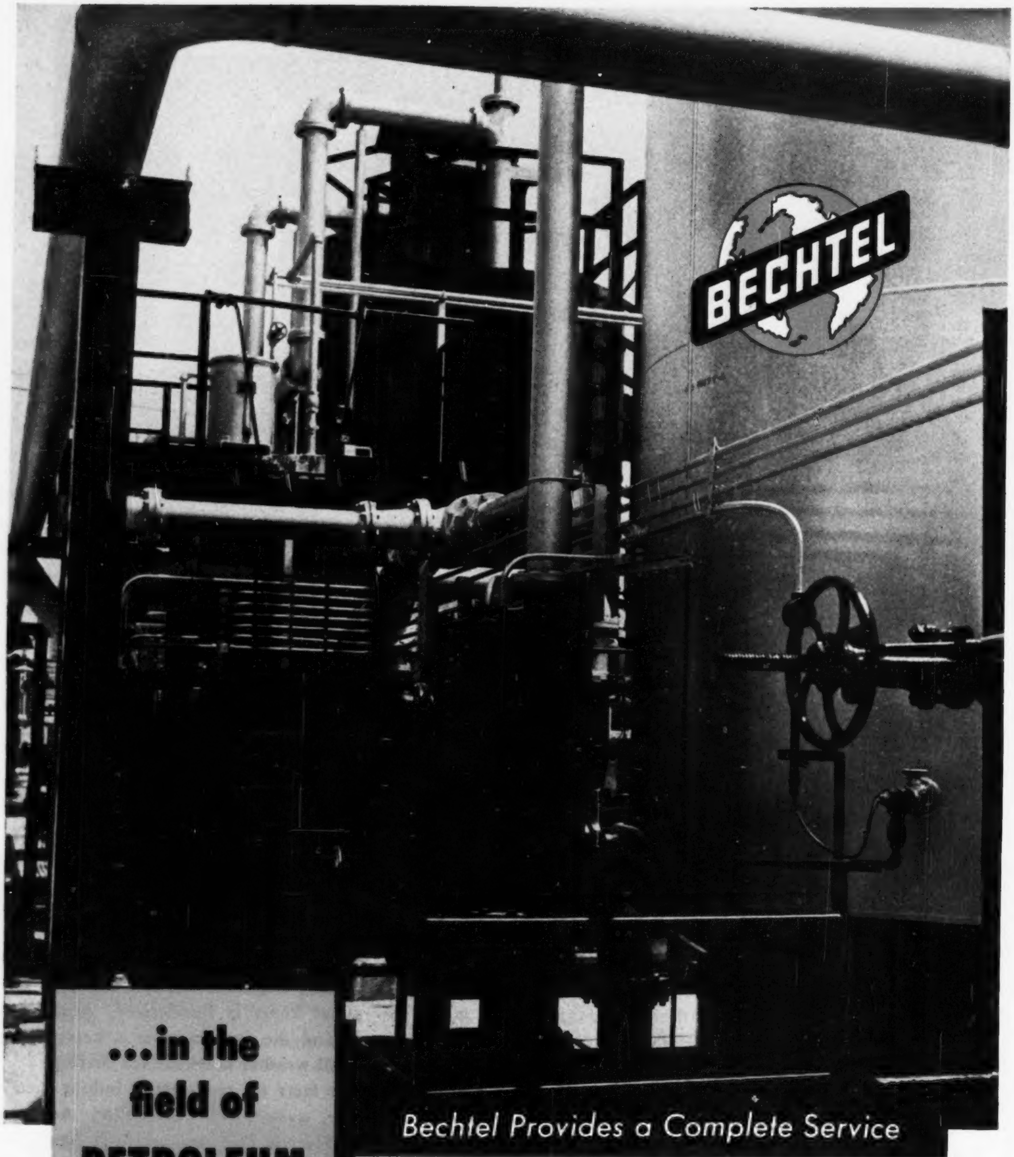
Weatherproof Construction—Utilizing rigid, self-supporting, jig-welded construction features, Westinghouse Outdoor Metal-Clad Switchgear is equipped with a weatherproof housing, special underframe or base, and access doors at both front and rear of the unit. Space heaters and special ventilators in each unit reduce the possibility of condensation. As long-term protection against rust and corrosive elements, the metal frame is Bonderized, prime and finish painted, and the base receives a heavy spray application of all-weather undersurface coating.

For complete facts on outdoor or indoor metal-clad switchgear, write for Booklet 5306. Address: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60793

DESIGN TESTED AND VERIFIED in the Westinghouse HIGH POWER LABORATORY

YOU CAN BE SURE...IF IT'S Westinghouse

METAL-CLAD SWITCHGEAR



...in the field of PETROLEUM PROCESSING

Portion of condensate filtration plant recently completed for Union Oil Company, as part of Wilmington Refinery expansion program.

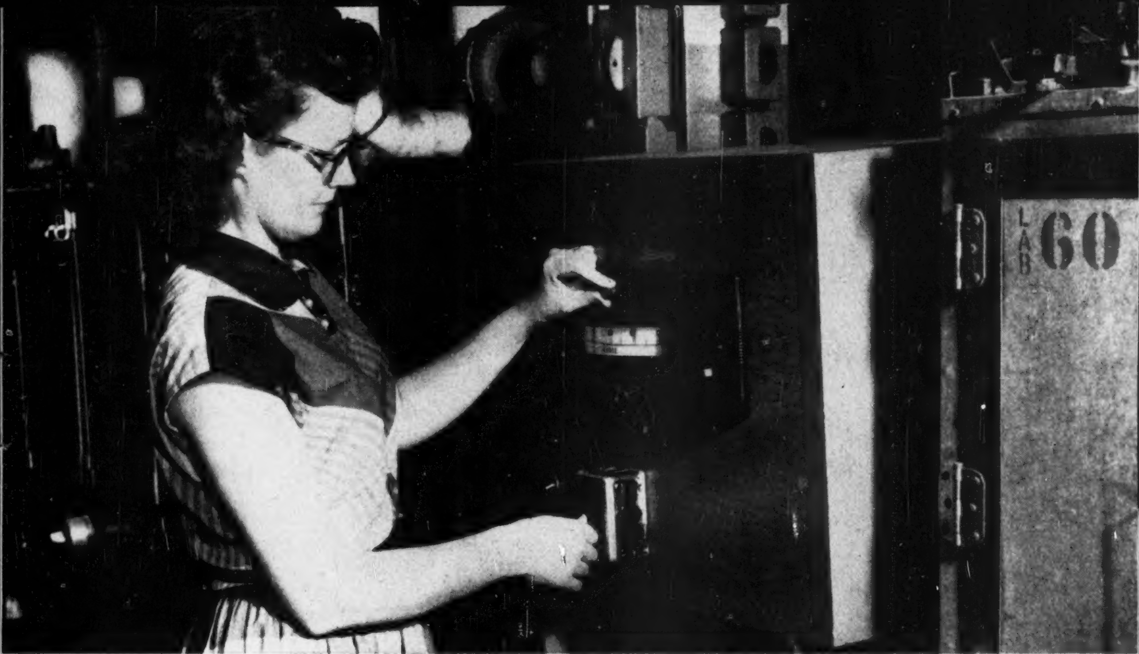
...analysis, design, engineering, procurement and construction

...completely integrated refineries or individual processing units.

BECHTEL CORPORATION

BUILDERS FOR INDUSTRY

Los Angeles • **SAN FRANCISCO** • *New York*



FOR MEASUREMENTS FROM −100 F TO −300 F, G.E.'S TYPE HP-13 ON-OFF CONTROLLER GIVES STABILITY, ACCURACY, AND CONTROL SENSITIVITY

G-E Resistance-thermometers have High Accuracy; Can Be Calibrated within 1/2 of 1% Full Scale

Temperatures from −100 F to −300 F can now be accurately indicated and controlled with General Electric's new line of resistance-thermometers. If you have an operation which demands close, accurate control, then there is a G-E resistance-thermometer tailored to your needs. Under certain conditions accurate indication is within ½ of 1 per cent full scale.

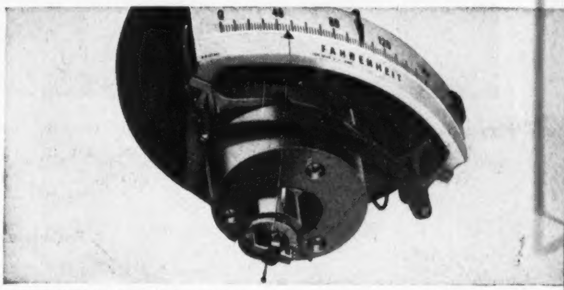
CONTROL SENSITIVITY is built into G-E resistance-thermometers. A pointer motion not exceeding 0.1 per cent full scale length causes on-off operation in the presence of variations in voltage, ambient temperature, and frequency.

SPECIAL FEATURES include a mercury switch, rated 35 amperes for 120 volts a-c or 25 amperes for 240 volts a-c, available as an optional accessory for applications where heating loads exceed 10 amperes. When larger electrical capacity than that afforded by either control relay or mercury switch is required, a magnetic contactor can be supplied.

WIDESPREAD USE of G-E resistance-thermometers is a testimonial to their value. These close-control instruments can be used in refrigeration and food-processing industries, air-conditioning, medical and research laboratories, and in many applications where close control is a necessity.

MORE INFORMATION is available. Contact your nearest G-E representative, or write Section 602-230 for Bulletin GEC-835. *General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC



BASIC ELEMENT of G-E resistance-thermometers is crossed-coil moving element and 3¼-pound alnico V magnet; designed to stand abuse.

TYPE HP-14 three-position resistance-thermometer with two-plug-in control units; shown with covers removed for easier maintenance.

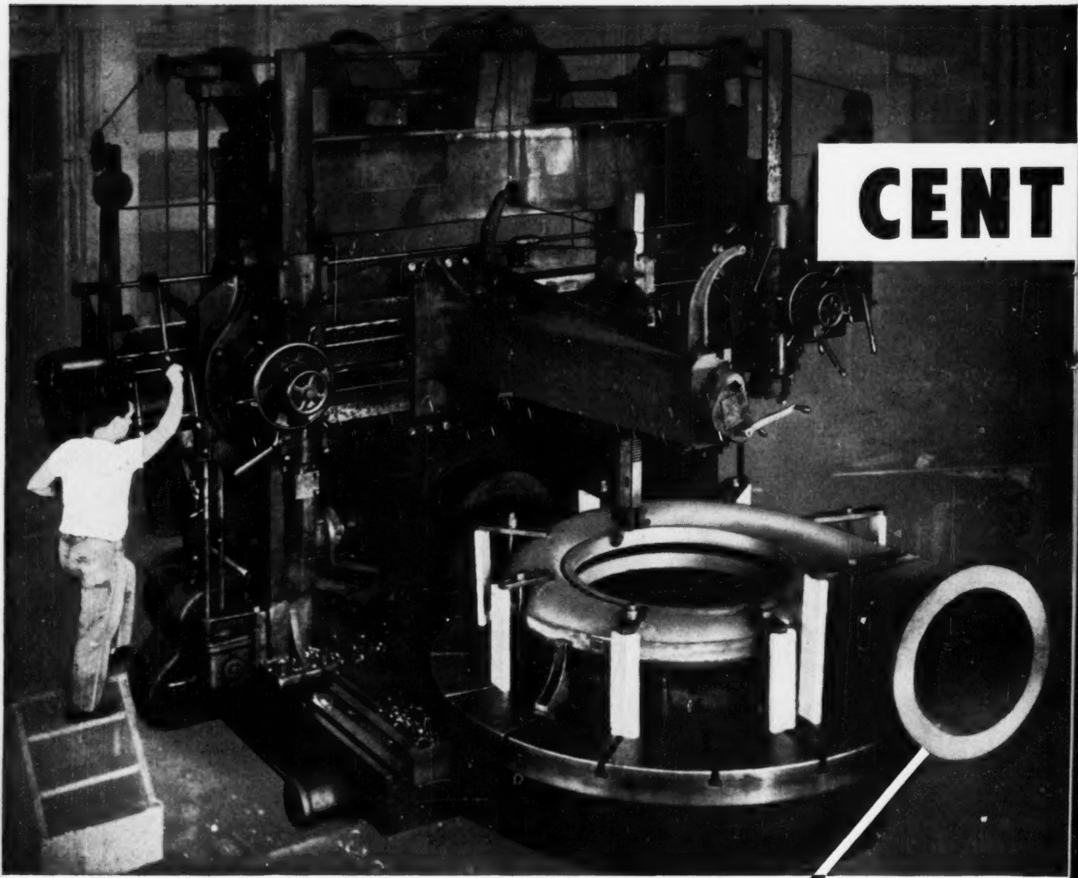
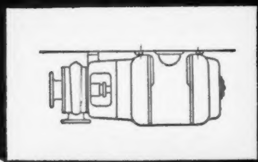


Illustration of a large compressor volute casing being machined at the Detroit works on a vertical boring mill having a 16-ft. swing.

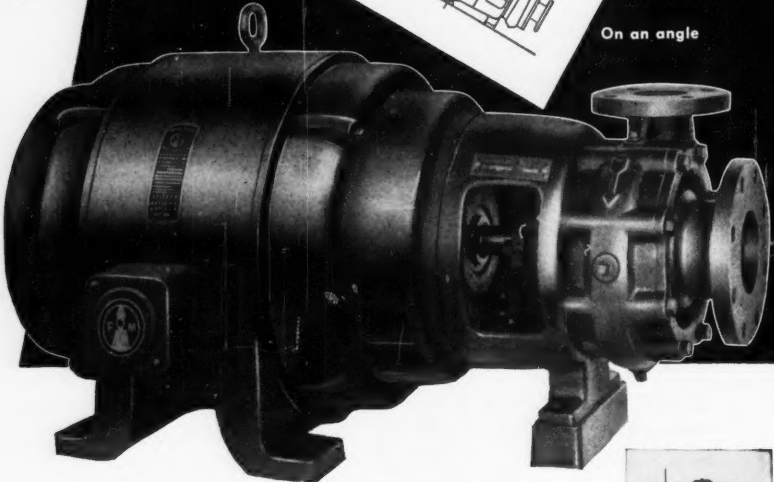
SQUEEZED FOR SPACE?

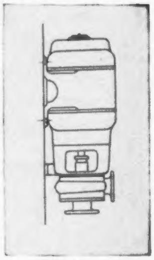
Fits anywhere
—any way



Upside down

On an angle



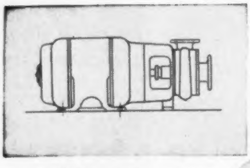


Vertically

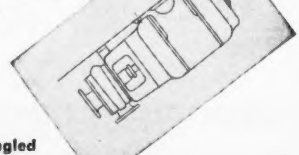
If plant expansion pains have you squeezed for floor space, Fairbanks-Morse *Builtogether* Centrifugal Pumps can help solve your problems.

These compact, efficient pumps can be mounted horizontally, vertically, or on an angle . . . on the floor or from the ceiling. Backed by the Fairbanks-Morse reputation for quality, these pumps will always deliver outstandingly dependable performance. An important extra advantage to you is the fact that both motor and pump are built by Fairbanks-Morse . . . your assurance of efficient service.

Fairbanks-Morse Builtogether Pumps are available in both single and two-stage models . . . in capacities up to 1000 gallons per minute against heads up to 550 feet. For complete information, see your local Fairbanks-Morse Branch, or write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.



Horizontally



Angled
upside down

FAIRBANKS-MORSE,

a name worth remembering

PUMPS · DIESEL LOCOMOTIVES AND ENGINES · ELECTRICAL MACHINERY · SCALES
HOME WATER SERVICE EQUIPMENT · RAIL CARS · FARM MACHINERY · MAGNETOS

Accidental Thermal Shock?

. . . THERE'S NOTHING FRAGILE ABOUT

Lapp TUFCLAD

SOLID Chemical Porcelain ARMORED with Fiberglass-Reinforced Plastic

Now you can gain the advantage of solid chemical porcelain purity and chemical resistance in a system which offers extra protection to personnel, equipment and product. Lapp TUFCLAD armor—multiple layers of Fiberglass fabric impregnated and bonded to the porcelain body with an Epoxide resin of high strength and chemical resistance—cushions accidental blows, insulates against thermal shock. Besides, it is itself tough and strong—will hold operating pressures against gross leakage, even if porcelain is cracked or broken. WRITE for description and specifications on Lapp TUFCLAD porcelain valves, plug cocks, safety valves, flush valves, pipe, fittings and special shapes.

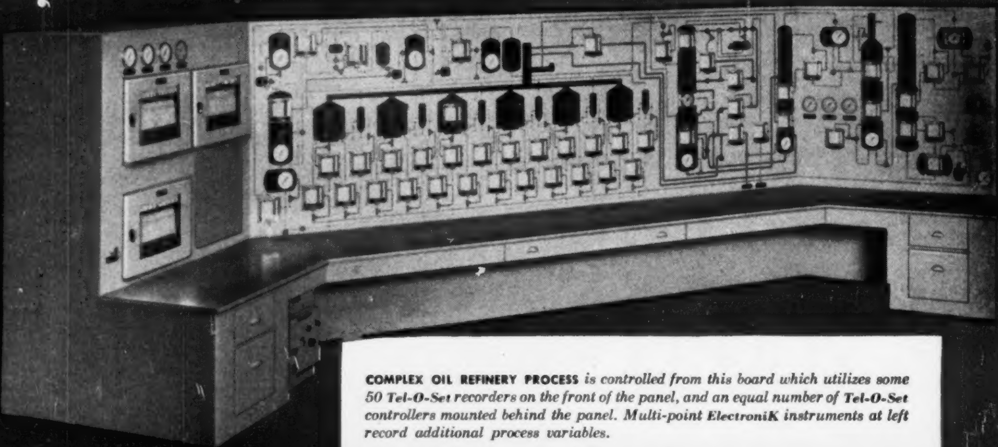
Lapp Insulator Co., Inc., Process Equipment Division, 516 Maple St., Le Roy, N. Y.

Lapp

PROCESS EQUIPMENT

CHEMICAL PORCELAIN VALVES • PIPE • RASCHIG RINGS

PULSAFEEDER CHEMICAL PROPORTIONING PUMPS

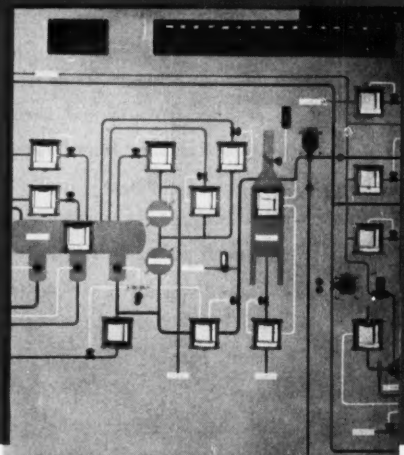


COMPLEX OIL REFINERY PROCESS *is controlled from this board which utilizes some 50* ***Tel-O-Set*** *recorders on the front of the panel, and an equal number of* ***Tel-O-Set*** *controllers mounted behind the panel. Multi-point* ***ElectroniK*** *instruments at left record additional process variables.*

Graphic Panels for Centralized Instrumentation...

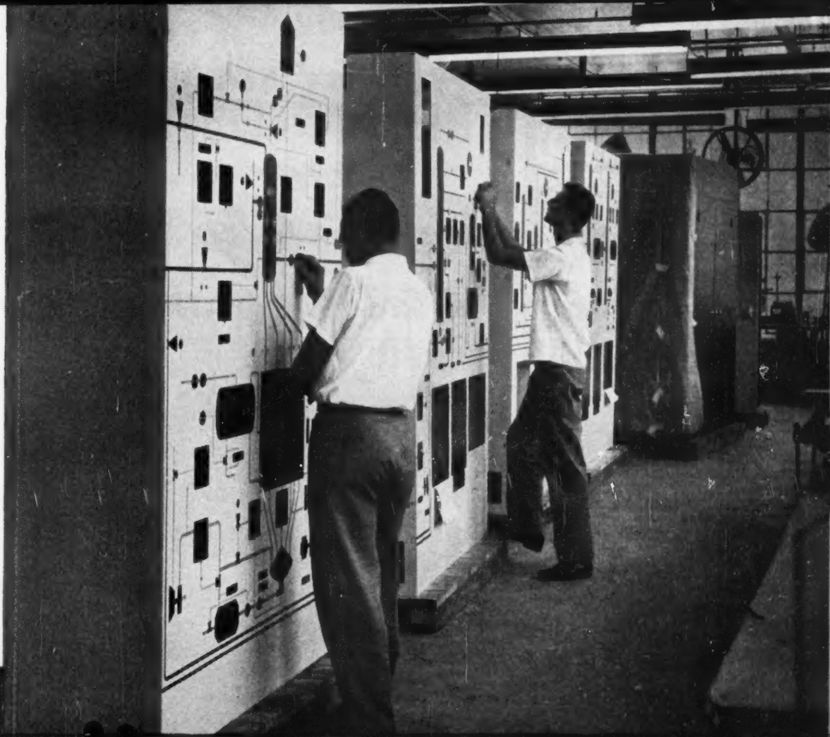
These well-known companies are taking advantage of Honeywell's specialized knowledge in the design, construction and operation of graphic panels:

Bechtel Corporation
C. F. Braun
Canadian Oil Refineries
Catalytic Construction Co.
Cooperative Refinery Association
Day & Zimmerman Inc.
Derby Oil Co.
Farmers Union Central Exchange Refinery Inc.
The Fluor Corporation Ltd.
Foster-Wheeler Corp.
Great Lakes Refinery
Imperial Oil of Canada
Inter-Mountain Chemical
International Refineries, Inc.
Kanotex Refining Co.
The Lummus Company
Northwestern Refinery
Pan-Am Southern
Phillips Petroleum Co.
The Refinery Engineering Co.
Rohm and Haas Co.
Shell Oil Co.
Sinclair Refining Co.
Socony-Vacuum Oil Co.
Southwestern Engineering Co.
Standard Oil Co. of California
Standard Oil Co. of Indiana
Standard Oil Co. of New Jersey
Sunray Oil Corp.
Sutherland Refiner Corp.
Union Oil Co. of California
Vickers Petroleum



FUNCTION-DESIGNED CONTROL *for a large refinery includes this section in a large graphic panel by Honeywell—using front-of-panel Liquid Level Indicators and* ***Tel-O-Set*** *recorders, plus* ***Tel-O-Set*** *controllers behind the panel.*

PANEL PRODUCTION
in Honeywell's extensive shop, devoted exclusively to panel work—utilizes the skills of highly trained specialists. All instruments, controllers, accessories, and back of panel wiring and piping are carefully assembled —then subjected to rigorous tests to assure trouble-free installation and start-up when the panel reaches your plant.



. . . a progress report from Honeywell

SHOWN at the left are just two of the many graphic instrument panels which Honeywell has supplied for centralized control of a wide variety of industrial processes. Each one is the result of well-seasoned engineering know-how . . . based on extensive Honeywell experience . . . which combines all instruments and accessories into a closely integrated, efficient design.

Whether your process calls for a full graphic or semi-graphic panel . . . a conventional board . . . or a control cubicle . . . you can be sure of obtaining every feature of quality and performance that you need in a Honeywell panel.

In Honeywell's Panel Division, meticulous attention to engineering detail and highly developed construction techniques watch over every step—from blueprint to assembly to final test. Add to this engineering and manufacturing skill the availability of a complete line of conventional and miniature instruments, and the result is a control board . . . custom-fitted to your needs . . . that makes *Panels by Honeywell* synonymous with the best in centralized control.

Our local engineering representative will be glad to discuss how graphic panels by Honeywell can bring new efficiency to your processes. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4478 Wayne Avenue, Philadelphia 44, Penna.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

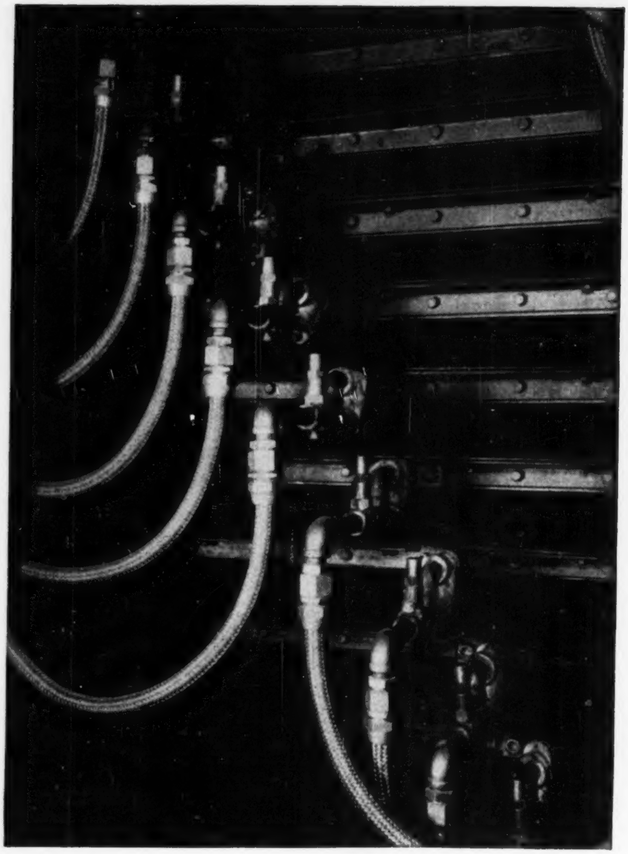
H
HONEYWELL

● *Important Reference Data*

First in Controls

Write for your copy of Bulletin No. 85-20, "Centralized Instrumentation . . . unlimited."

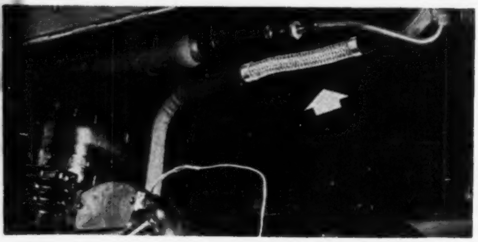
News about flexible metal connectors



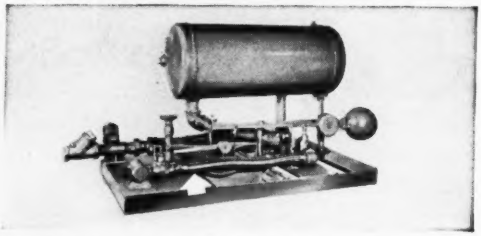
Here they prove dependable for

PRESSURE, COLD and HEAT

PRESSURE Harbor Plywood's veneer press uses American ½" I.D. Seamless Bronze Connectors with braid for added pressure resistance. American Flexible Metal Connectors are ideal for this use because they're corrosion-resistant. They come with fittings attached and are easily installed. Manufacturers, like Harbor Plywood, find American Connectors the right solution to tough design problems because of their flexibility, both in assembly and operation, and their long life with little maintenance attention.



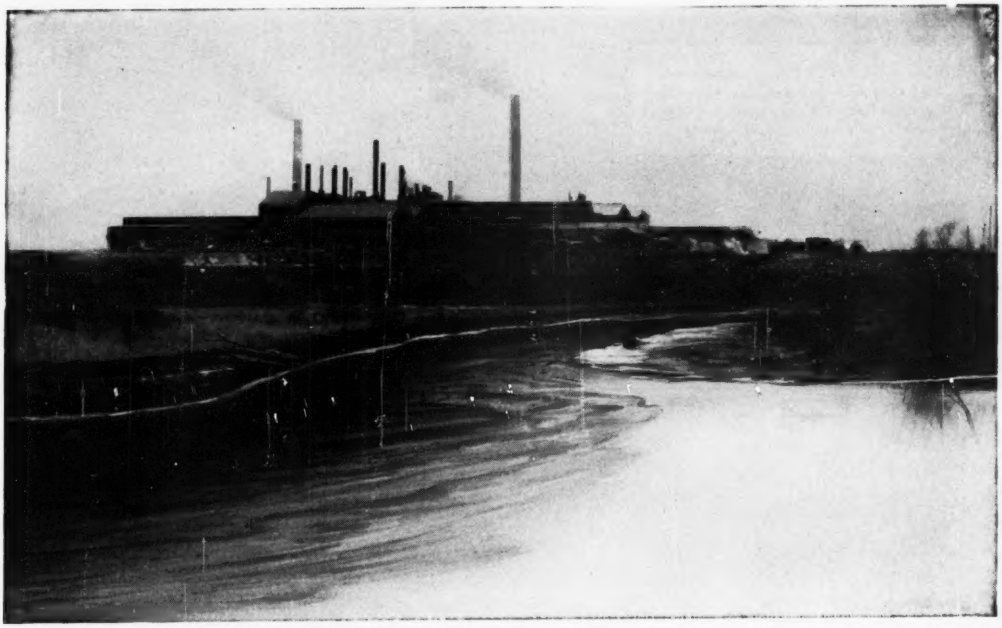
COLD For conveying Freon in truck refrigeration systems, The Schnabel Co. uses American Vibration Eliminators. These connectors operate between 10° and 40° F. at 180-200 p.s.i. American Flexible Metal Connectors are the best answer where moving lines must be connected, flexible shafts protected, or assemblies made in restricted spaces.



HEAT Morehead Manufacturing Company uses American Seamless Bronze Flexible Connectors on their "back to boiler" steam trap. This connector has the ability to resist high steam temperature and pressure as well. American Flexible Metal Connectors may also be used to carry corrosive liquids, gases, or semisolids. 52262

WRITE FOR BOOKLET SS-50—*shows how the tubing is designed, used, and installed—gives specifications on tubing and fittings. The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn. In Canada: The Canadian Fairbanks-Morse Company, Limited.*

wherever connectors must move... *American* flexible metal hose and tubing



WORRIED ABOUT WASTE DISPOSAL?

Bailey Meters Help you to Reduce Pollution

● The disposal of industrial wastes without stream pollution calls for careful planning and continuous vigilance.

That's where Bailey Meters and Controls come in. We measure the flow and pH of sewage, sludge, and industrial wastes flowing in open channels or pipe lines. These and other factors, such as levels, rates of chemical feed, and flow of air, may be co-ordinated into a completely automatic system for the treatment and disposal of waste materials.

When you want fast, complete and authoritative answers to the measurement and control aspects of your waste disposal problems, reach for your phone and call your local Bailey Engineer. Offices in all principal industrial centers.

P-24

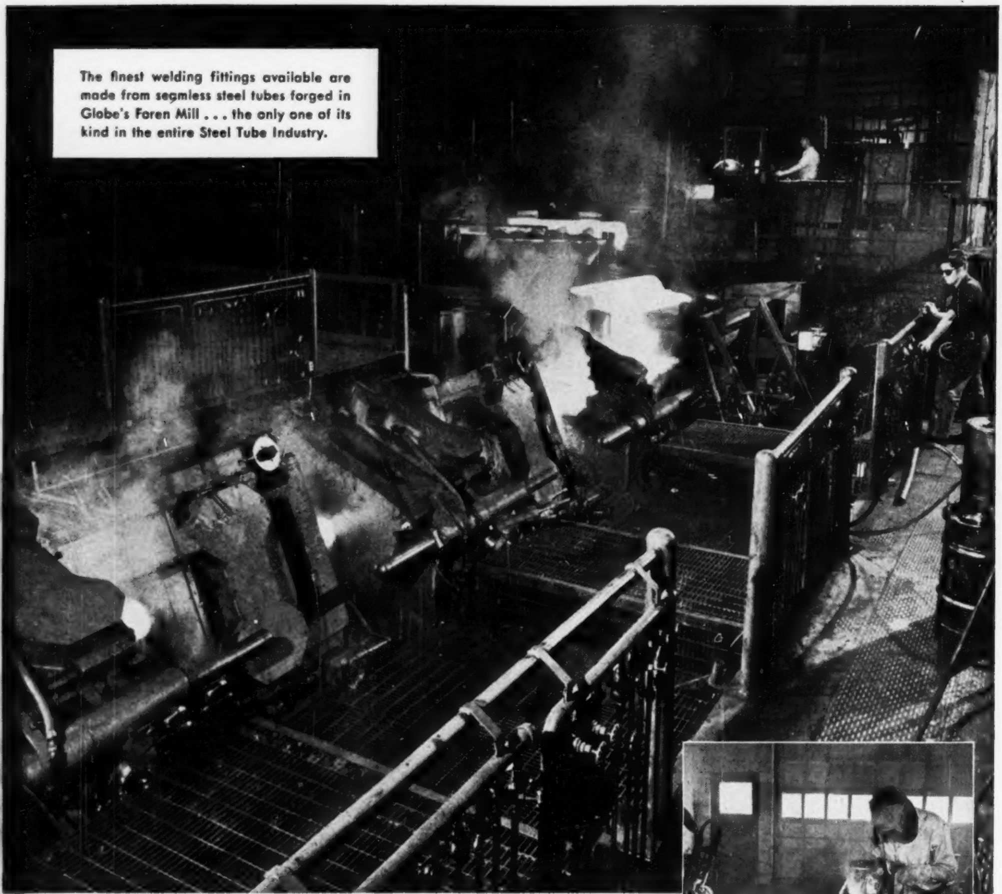
BAILEY OPEN CHANNEL METERS

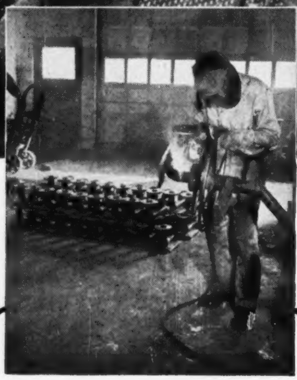
These indicating, recording and integrating meters are suitable for measuring industrial wastes, sewage, sludge, corrosive liquids, and irrigation water flowing in all types of open channel primary metering devices, such as Venturi flumes, weirs, or nozzle flumes. Electric or pneumatic telemetering permits location of receivers wherever desired. Ratio of flows and chemical feeds may be controlled automatically.

BAILEY METER COMPANY

1054 IVANHOE ROAD
CLEVELAND 10, OHIO

Process Controls
TEMPERATURE · FLOW
PRESSURE · LEVEL
GAS ANALYSIS · RATIO





GLOBE WELDING FITTINGS ARE BORN HERE

Only Globe seamless welding fittings are precision processed from *billet* . . . to *tube* . . . to *fitting*

Globe precision-process manufacture begins with the billet — continues through the making of the seamless steel tube — and extends through to the production of the finished fittings.

The exacting controls in Globe's precision process — plus specialized research, testing and engineering insure uniform high-quality and close tolerances. Be sure of dependable fittings . . . always specify Globe.

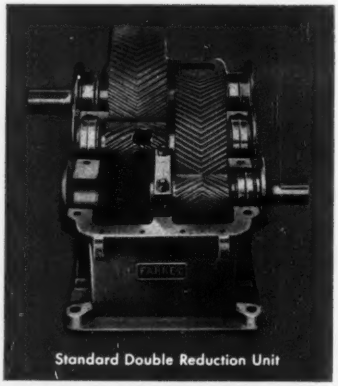
For complete information on the finest welding fittings available anywhere, send for the Globe Welding Fittings Catalog.

GLOBE STEEL TUBES CO., Milwaukee 46, Wisconsin

Chicago • Cleveland • Detroit • New York • Philadelphia • St. Louis
Denver • Houston • San Francisco • Glendale, Cal.

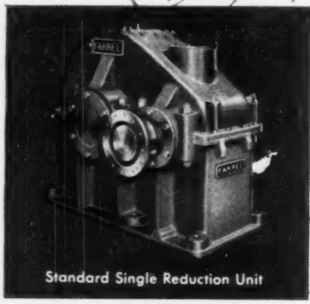
Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — alloy — carbon — seamless steel tubes — Globeiron (high purity ingot iron) seamless tubes — Globe Welding Fittings.

FIVE ANSWERS TO SPEED REDUCER PROBLEMS

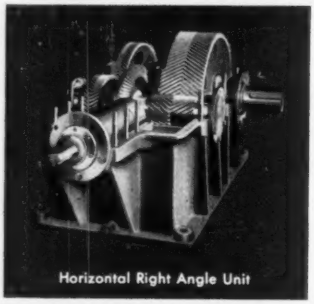


Standard Double Reduction Unit

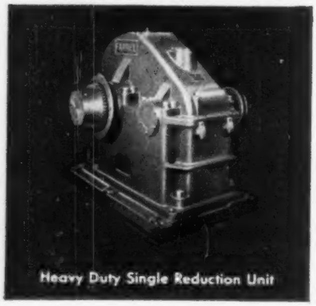
Unit with pinion on extended shaft supported by outboard bearing



Standard Single Reduction Unit



Horizontal Right Angle Unit



Heavy Duty Single Reduction Unit

Farrel speed reducers are made in a number of different types, with a wide range of ratios and capacities. Designs include single, double and multiple reduction units, speed change units having two or more selective speeds, right angle drives, and drives to meet special requirements.

All units are supplied with precision gears, generated by the famous Farrel-Sykes process for smooth, quiet, efficient power transmission; shafts and bearings factored to safeguard against interruption of vital processes; gear cases proportioned to withstand repeated heavy peak loads; joints sealed to prevent entrance of dirt.

Send for further details of these designs. Ask for a copy of Bulletin 449 — no cost or obligation.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N.Y.
Sales Offices: Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Detroit, Chicago, Minneapolis, Portland (Oregon), Los Angeles, Salt Lake City, Tulsa, Houston, New Orleans

FB-745

Farrel-Birmingham®


CHEMICALS
No Mixing Job is Too
GRAPHITE LEADS AND CRAYON STOCK
CATALYSTS
WELDING ROD COATINGS
INSECTICIDES
. . . NO PRODUCTION SCHEDULE TOO RIGID FOR THE MULLING PRINCIPLE OF MIXING
In the Simpson Mix-Muller you have a modern production machine embodying a time-tested mixing principle. For the true mulling principle is similar to the rubbing, kneading and smearing action of a mortar and pestle. This assures a more thorough, more accurate blend of all materials . . . and every batch is exactly the same for complete product uniformity.
Simpson Mix-Mullers are built in capacities ranging from 1/10 to 30 cu. ft. They may be specially equipped for heating or cooling while mixing—for mixing under vacuum or pressure—for corrosive materials—or to function as a reaction vessel.
SIMPSON Mix-Muller Division
NATIONAL ENGINEERING CO.
604 Machinery Hall Bldg., Chicago 6, Ill.

It's the Nash!

The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintain 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

Nash Compressors have no valves, gears, pistons, sliding vanes or other enemies of long life. Compression is secured by an entirely different principle of operation, which offers important advantages often the answer to gas handling problems difficult with ordinary equipment.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature Automatically maintained.

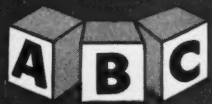
Slugs of liquid entering pump will do no harm.

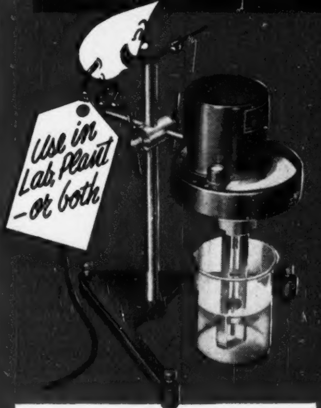
75 pounds in a single stage.

NASH ENGINEERING COMPANY
312 WILSON, SO. NORWALK, CONN.

VISCOSITY DETERMINATION AND CONTROL

Made as Easy as . . .





Just a flick of a switch, then read the dial, and with a Brookfield Synchro-Lectric Viscometer on the job you have your viscosity determination in centipoises. The whole operation, including cleaning up, usually takes only a minute or two.

Available in a variety of models* suitable for extremely accurate work with both Newtonian and non-Newtonian materials. Brookfield Viscometers are portable and plug into any A.C. outlet — can be used in Lab, Plant or both.

Write today for fully illustrated catalog showing Brookfield Viscometers and accessory equipment adaptable to any viscosity problem from less than one to 32,000,000 centipoises.

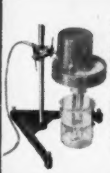
*New eight-speed (ratio 200 to 1) models as well as four-speed (ratio 10 to 1) and single-speed models are available in various R. P. M.'s up to 100. Each Brookfield Viscometer is accompanied by a complete set of suitable spindles, a convenient spindle holder, and a compact carrying case that holds both the Viscometer and the spindles.

UL ADAPTER

When attached to LV models of the Brookfield Viscometer, the Brookfield UL Adapter, consisting essentially of a cylindrical spindle mounted symmetrically within a concentric tube, provides amplifying effects which make possible measurements to within .2 millipoises in the ultra-low viscosity range of .2 to 10 centipoises.

HELIPATH STAND

When used in conjunction with a suitable Brookfield Viscometer fitted with a special bar-type spindle, the Brookfield Helipath Stand lowers the rotating spindle through the test material, making possible the testing and study of highly plastic materials such as grease, putty, shaving cream, gelatin, shortening, etc.



LEVELING STAND

Designed to provide firm, easily-leveled support for a Brookfield Viscometer when used either by itself or equipped with a UL Adapter, the three-point screw-leveled base and adjustable elevation clamp of the Brookfield Leveling Stand insure fast set-ups and trouble-free determinations.

BROOKFIELD VISCOTROL

Makes Possible Continuous and Automatic Viscosity Control

Based on the same simple yet highly accurate operating principles employed in the portable Brookfield Synchro-Lectric Viscometer, the Brookfield Viscotrol is designed for use where viscosity variations during production normally occur only in one direction. When installed in such tank, vat or pipe production systems, the Brookfield Viscotrol continuously measures the viscosity of the material in process. If a variation occurs, the unit automatically activates danger signals and/or other viscosity controlling devices. *Write today for Data Sheet 012.*

If your problem involves Viscosity Determination or Control — ASK BROOKFIELD

Save Time, Labor, Dollars!

WITH BROOKFIELD INSTRUMENTS

Precision manufacturing and sturdy design, combined with ingenious application of the old and simple principle of measuring with a calibrated spring the torque on a spindle rotating at a constant speed, have resulted in Brookfield instruments becoming the standard the world over for the accurate, fast and direct determination of viscosity and related properties. *Use the convenient coupon below.*

Brookfield
ENGINEERING LABORATORIES, INC.
STOUGHTON, MASSACHUSETTS

Brookfield Engineering Laboratories, Inc.
Stoughton, Massachusetts C

Gentlemen:

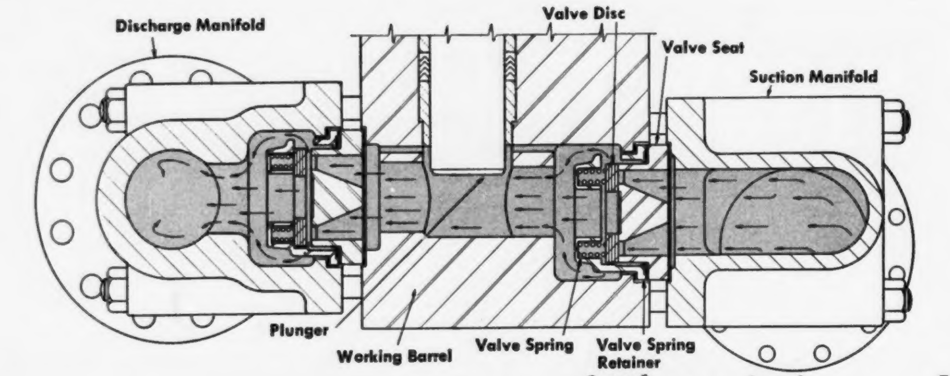
Please send me the literature items I have checked below:

☐ Fully illustrated catalog showing all portable Brookfield Viscometers and accessories.

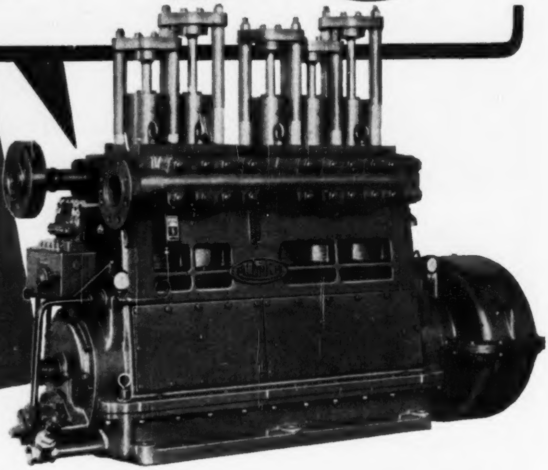
☐ Brookfield Viscotrol Data Sheet 012.

Name: ____________________

Address: ____________________



ENGINEERS: Check these points of Aldrich Direct Flow Design



Aldrich engineers eliminated two right-angle turns in the fluid-end. Now, liquid passes from suction to discharge manifold in a *straight line.* That gave the Direct Flow Pump its name, and set up a whole new concept of pumps, pumping, and pump maintenance. It all adds up as follows:

☐ **Increased operating speeds**—you get whatever volume and pressure you need *from a smaller, lighter, more compact pump.*

☐ **Sectionalized construction**—parts can be replaced at a fraction of the cost of a new fluid-end; also, parts can be made of stainless, bronze, Monel or other special materials—extremely important for corrosive fluid service.

☐ **Maintenance made easier**—no more tapered bores in the working barrel. Manifolds are *not* taken off but slide out on studs—affording room to *lift out* valves as complete units. Packing is easily renewed—note accessibility of stuffing boxes.

☐ **Interchangeable wearing parts**—available among 3, 5, 7 and 9 plunger pumps of same stroke size. This minimizes spare parts costs and inventories.

☐ **Changeable plunger sizes**—in many cases it is only necessary to add new plungers, glands, throat bushings and packing *to the same fluid-end.*

☐ **Drive direct**—by connection to synchronous engine type motor or internal combustion engine; also with integral speed reducer or V-belts.

Contact your Aldrich Representative . . . or write to us direct for complete details on 3", 5" or 6" stroke units.

THE ALDRICH PUMP COMPANY ...*Originators of the Direct Flow Pump*

3 GORDON STREET • ALLENTOWN, PENNSYLVANIA

Representatives: Birmingham • Bolivar, N. Y. • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Detroit • Duluth • Houston • Jacksonville • Los Angeles • New York • Omaha • Philadelphia • Pittsburgh • Portland, Ore. • Richmond, Va. • St. Louis • San Francisco • Seattle • Spokane, Wash. • Syracuse • Tulsa • Export Dept.: 751 Drexel Building, Phila. 6, Pa.

How porous *do you want your* catalyst supports?

Norton catalyst supports come in two types:

1. If your process calls for coated catalyst supports, you get what you want from Norton medium-porosity spheres. They have a porosity of 30-35%, with a rough, open surface structure. This gives you maximum adherence of catalyst to surface.

2. If you need supports for impregnation, Norton high-porosity spheres are your choice. Their porosity is 42-47% with large, connected, internal pores uniformly dispersed throughout the support. This gives you maximum deposition of catalyst.

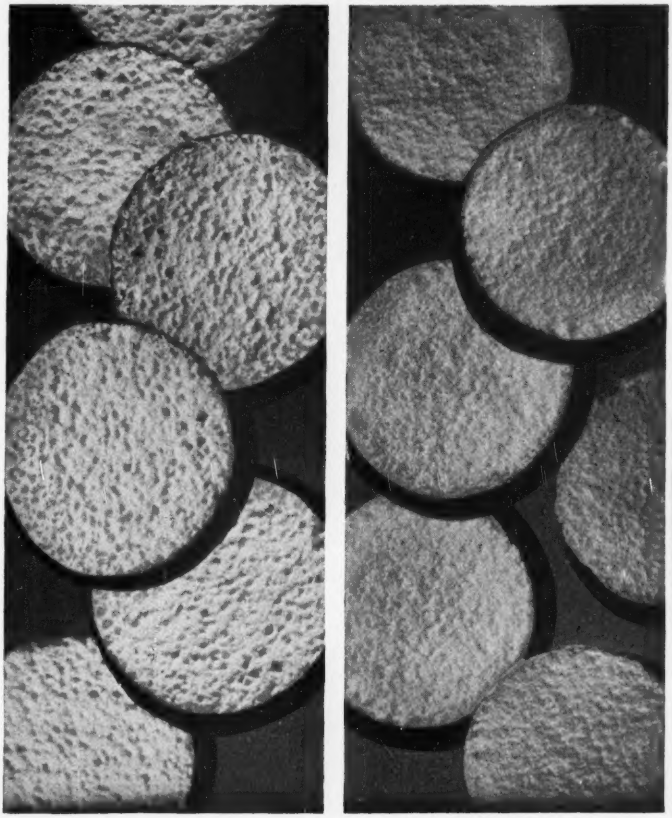
You also have a choice of sizes and shapes. Norton spheres are available in diameters of 3/16" to 1". Other Norton catalyst supports, in ring and pellet form, available in diameters of 1/8" to 2".

A choice of materials, too. Norton catalyst supports can be made from a variety of refractory materials, offering many different combinations of properties.

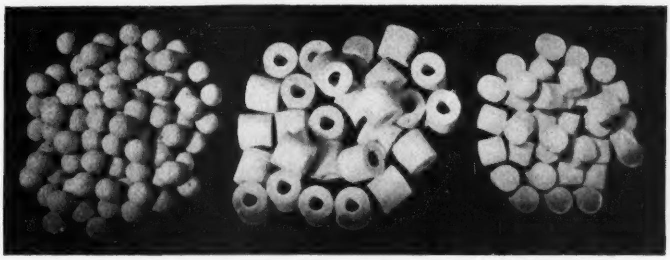
Test them in action

You can easily prove, in your own plant, what Norton catalyst supports can do towards improving your production. Want to see samples? Contact your Norton representative or write direct to Norton Company, 511 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ont.

NORTON HEAT EXCHANGE PEBBLES also offer you worthwhile advantages, especially where alternating oxidizing and reducing atmospheres are met. They're made of ALUNDUM* electrically fused alumina (alumina content 95% to 99%). Nothing like them for static or moving heat exchange beds.



Greatly enlarged views of cross-sections of the two types of Norton catalyst support spheres. *Left: Norton High-Porosity Spheres* have connected pores throughout. *Right: Norton Medium-Porosity Spheres* have pores close to surface. You can also get Norton Low-Porosity Spheres if required.



Norton catalyst supports are made in sphere, ring, and pellet form.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON

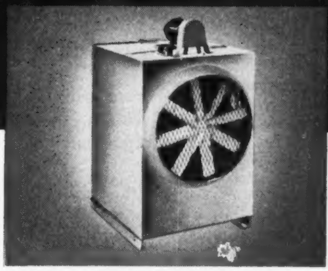
Special REFRACTORIES

Making better products to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

Fastenings of rustproof EVERDUR prevent this:

Cheap enough to install — but fastenings that rust are costly in the long run for the customer and the manufacturer.



Only 73¢ more total cost. But by using fastenings of EVERDUR, rather than ordinary bolts, Halstead & Mitchell make it possible to disassemble cooling towers, *even after years of exposure to all weather extremes.*

For the customer, equipment fastenings that rust in service mean *extra* labor costs in dismantling. To the manufacturer, a dangerous loss of prestige. Design engineers can easily avoid these troubles by specifying bolts, screws and accessories made of EVERDUR*—*strong, tough, rustproof* and *corrosion-resistant.*

EVERDUR Copper-Silicon Alloys also have many other structural and engineering uses — in sewage and water works installations, chemical processing plants, marine and pole line hardware, air-conditioning equipment, etc. They are easily fabricated and welded. They are available in all the usual forms: sheet, wire, rod, bar, tube, angle, channel, T- and I-beams and casting ingots. EVERDUR can help you build longer service life into equipment subject to unusual stress, severe weather, under-water or other corrosive conditions. For further information on EVERDUR Alloys for Bolts, Screws and Accessories, write for Publication E-6. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

*Registered U. S. Pat. Off. 52161A

EVERDUR

ANACONDA®

COPPER-SILICON ALLOYS

STRONG • WELDABLE • WORKABLE • CORROSION-RESISTANT

Here are your ARMSTRONG TRAP REPRESENTATIVES who offer you:

NEARNESS —you don't have to look far or wait long for an Armstrong Man. There are 39 Factory Representative organizations and 135 stocking jobbers in the United States, Canada and Mexico. Armstrong traps and trap service are near wherever you may be.

SERVICE —what size trap for this job?—how to hook it up?—cold machines?—mysterious difficulties? Your Armstrong trap man will know or find the answer for you. He is factory-trained and, more importantly, he has lots of experience to help you.

RELIABILITY —Armstrong Representatives are "solid citizens," established in their communities—men who will perpetuate their organizations assuring you continuity of experience and service.

TRAPS —no delay when you need traps—local stocks are adequate for most requirements.

PARTS —most Armstrong Representatives have complete stocks of trap parts on which you can draw.

OVERHAULS —many Armstrong Representatives offer complete trap repair and "factory overhaul" service.

When you specify Armstrong traps, you'll get no "orphans." The parental interest of the sales and service organization goes with them.

SEND FOR YOUR FREE COPY OF THE 44-PAGE ARMSTRONG STEAM TRAP BOOK

ARMSTRONG MACHINE WORKS
858 Maple Street, Three Rivers, Michigan

ARMSTRONG "INVERTED BUCKET" STEAM TRAP

ARMSTRONG

1. Armstrong Representatives at Armstrong Factory Sales Meeting, 1952.

2. Trap and parts stocks, Allen T. Shepherd Co., Armstrong Factory Representative, Richmond, Va.

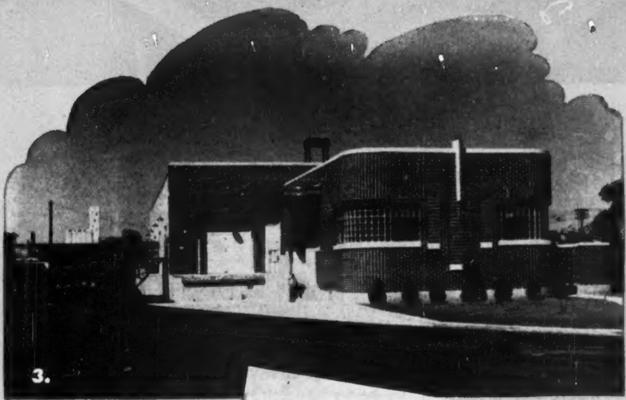
3. Office and Warehouse, Pace, Turpin & Co., Armstrong Factory Representative, Salt Lake City, Utah.

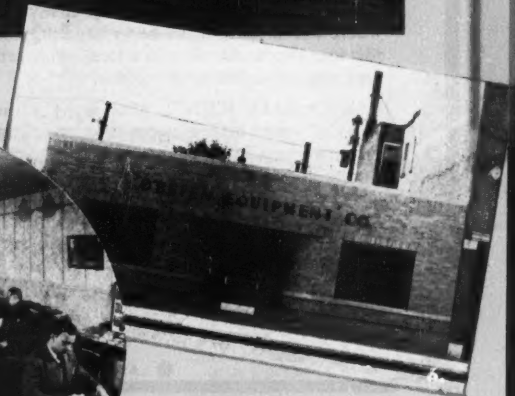
4. Trap and parts stocks, Barrett-Christie & Co., Armstrong Factory Representative, Chicago, Illinois.

5. Office interior, Wm. A. Milby Co., Armstrong Factory Representative, Baltimore, Md.

6. Headquarters of O'Brien Equipment Co., Armstrong Factory Representative, St. Louis, Mo.

● ***ARMSTRONG STEAM TRAPS are backed by Armstrong Service.***

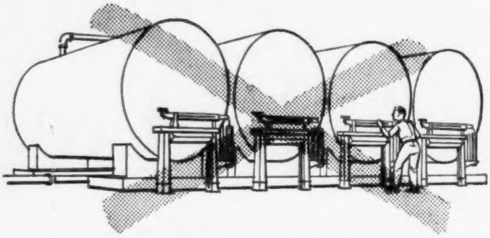




STEAM TRAPS

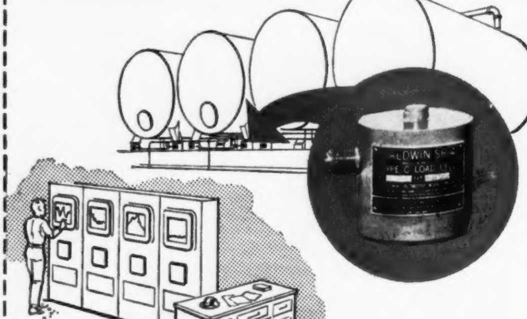
SATISFACTION or your money back

Weigh any tank anywhere in your plant from ONE location



ELIMINATE individual scales . . .

MODERNIZE with centralized readings . . .



With Baldwin SR-4® Load Cells you can completely eliminate the inefficient and troublesome use of the ordinary poise, lever and knife-edge weighing systems. Corrosion and accumulation of foreign material will no longer affect accuracies . . . cleaning problems will be simplified. Instead of taking readings at each tank . . . you will be able to weigh many tanks from *one* central control booth.

Only a few inches in height, these Baldwin SR-4® Load Cells are rugged, dependable, completely sealed and can be located under existing tank supports. The load cell has no appreciable movement and operates recorders, indicators, printers or control instruments through simple electrical circuits.

For complete technical information, write for Bulletins 306, 325, 326 and 328 describing Baldwin Load Cells, pressure cells and torquemeters.

BALDWIN - LIMA - HAMILTON

TESTING HEADQUARTERS

Eddystone Division, Baldwin-Lima-Hamilton Corporation

Philadelphia 42, Pa.

In Canada: Peacock Bros., Ltd., Montreal, Quebec

- *Permits use of ventilated air from packaging hoods to be used for conveying material*
- *Reduces required size of dust collecting unit as much as 50%*
- *Conveys material from any dust source (dryer, pulverizer, blender, tank, vat, etc.)*
- *Cools the conveyed material without mechanical refrigeration*
- *Spans distances up to 200 feet*
- *Will by-pass any obstacle in the form of existing machinery or equipment*

These and other advantages make the MIKRO Air Conveying System an ideal low-pressure, low-cost method of conveying material from any dust source. Its complete flexibility helps solve plant layout problems without costly flow sheet revisions.

This dust-tight installation conveys up to 800 grains of dust per cubic foot of air . . . Makes possible the return of filtered air to processing area, thus reducing loss of heated or conditioned air . . . Assures freedom from infestation and metallic contamination . . . Easily cleaned . . . Eliminates booster fan, thus preventing change in particle sizing.

The MIKRO Air Conveying System is more economical to install, operate and maintain than a conventional mechanical system. Even greater saving is effected when stainless steel or nonferrous construction is required.

*Patents applied for by H. J. Hersey, Jr. and Pulverizing Machinery Company

SEND FOR new MIKRO AIR CONVEYOR Bulletin

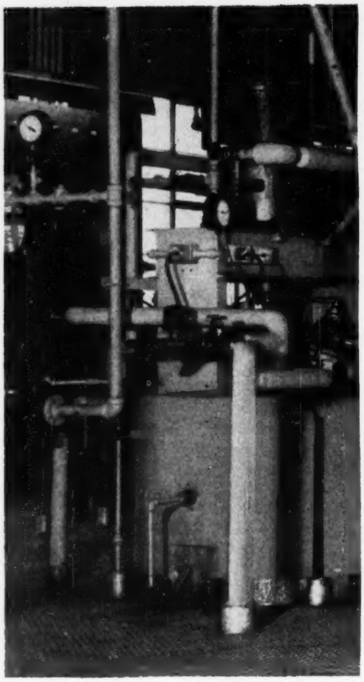
PULVERIZING MACHINERY COMPANY
55 Chatham Road **Summit, New Jersey**

PRESERVE OUR HERITAGE: FAITH, FREEDOM AND INCENTIVE

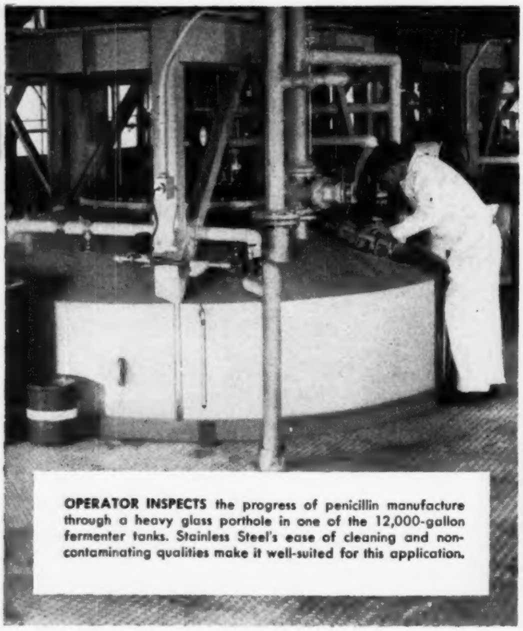
MIKRO-COLLECTOR 100 PER CENT
Reg. U. S. Pat. Off.
By the makers of
MIKRO-PULVERIZERS and MIKRO-ATOMIZERS

Stainless Steel equipment

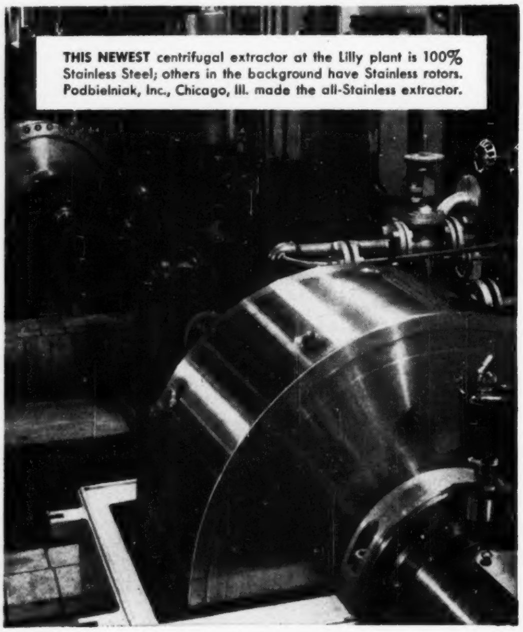
—easy to clean and non-contaminating



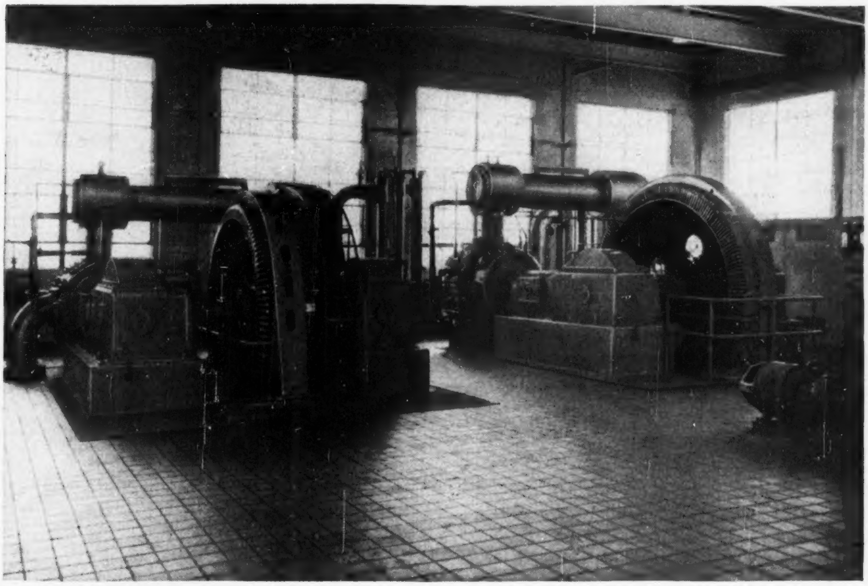
—helps make penicillin



OPERATOR INSPECTS the progress of penicillin manufacture through a heavy glass porthole in one of the 12,000-gallon fermenter tanks. Stainless Steel's ease of cleaning and non-contaminating qualities make it well-suited for this application.



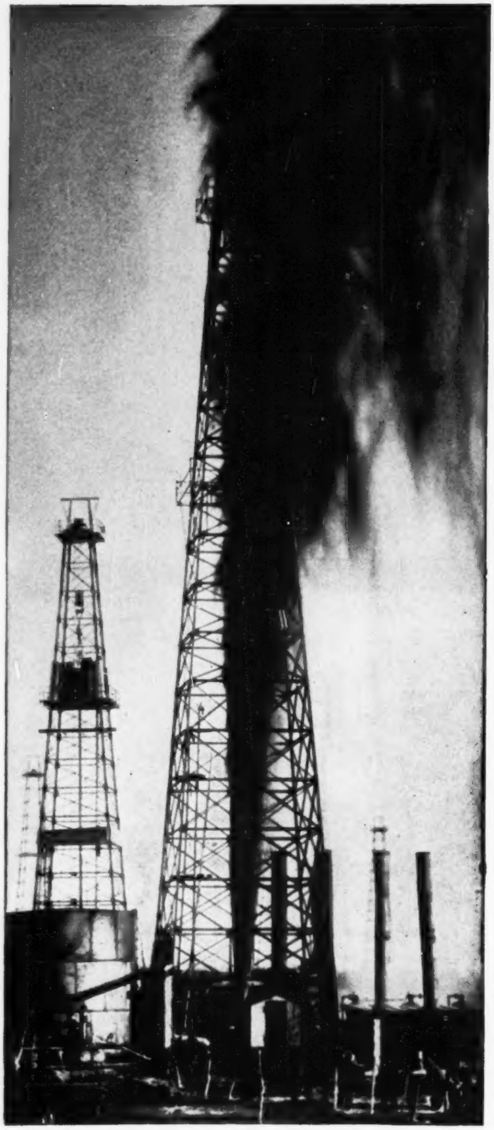
THIS NEWEST centrifugal extractor at the Lilly plant is 100% Stainless Steel; others in the background have Stainless rotors. Podbielniak, Inc., Chicago, Ill. made the all-Stainless extractor.



You can't stop a gusher with a bottle cap

You can't stop corrosion with ordinary paints . . .

it takes BITUMASTIC COATINGS!



CORROSION can't be stopped by ordinary paints or conventional protective coatings. They can't protect surfaces against the ravages of rust for any appreciable length of time.

But Bitumastic Coatings can!

Unlike maintenance paints, Bitumastic® Protective Coatings are specially formulated from a base* of coal-tar pitch that is, for all practical purposes, impervious to water. When you keep moisture away from an exposed surface, you *stop* corrosion.

Bitumastic Coatings provide an extra-tough, extra-thick barrier against corrosive elements—a barrier that is impenetrable. And these coatings provide up to 8 times the film thickness of conventional paint coatings.

Bitumastic Coatings stop corrosion caused by moisture—acid fumes—alkaline fumes—corrosive soil—salt air—heat.

**Hi-Heat Gray contains a metallic base.*

There are 6 Koppers Coatings—formulated to control corrosion of metal and deterioration of concrete. Use the coupon for full information.

SEND FOR SET OF FREE BOOKLETS!

Koppers Company, Inc., Tar Products Division
Dept. 1259-T, Pittsburgh 19, Pa.

Please send me, without charge or obligation, your booklets on corrosion prevention.

Name..

Address..

City......................Zone....State...........

KOPPERS BITUMASTIC PROTECTIVE COATINGS

SOLD THROUGH INDUSTRIAL DISTRIBUTORS

KOPPERS COMPANY, INC., Tar Products Division, Dept. 1259T, Pittsburgh 19, Pa.

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

. . . when you need a Compact Drive

. . . look for the Fairbanks-Morse Seal. On slow-speed applications, for example, you'll find the unique F-M Motorgear that combines reduction gears with the 40%-Shorter Axial Air Gap Motor to make a complete slow-speed unit—*more compact than the average motor alone!*

Whatever the drive problem on your equipment, the Fairbanks-Morse Seal is your assurance of top performance, minimized servicing . . . symmetrical design that improves appearance of the driven unit.

When you look for motors—one or a thousand . . . for standard or unusual applications—*always* look for the Fairbanks-Morse Seal. For over 120 years that seal has stood for the finest in manufacturing integrity to *all* industry. Fairbanks, Morse & Co., Chicago 5, Ill.

WITH ANOTHER

FAIRBANKS-MORSE

a name worth remembering when you want the best

ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES AND ENGINES • PUMPS
SCALES • HOME WATER SERVICE EQUIPMENT • RAIL CARS • FARM MACHINERY • MAGNETOS

SAVED FROM THIS WINGED KILLER ...FOR 22¢

This little fellow has twice the chance of reaching manhood since the Republic of Ceylon put through a DDT program against malaria mosquitoes. Here's a truly hopeful note from a harried world. Malaria is the world's most prevalent disease and kills three million people yearly, although its eradication is amazingly inexpensive. The DDT treatment in Ceylon cost only 22 cents per capita, yet it halved the death rate from all diseases.

One company in the United States alone turns out in one year enough DDT, among other pesticides, to rid several nations of malaria. This is the Kolker Chemical Works, Inc., recently acquired by DIAMOND ALKALI.

The whole United States spent for a full year's supply of pesticides (weed killers, plant hormones, as well as insecticides) only $250,000,000; about the cost of 33 hours of World War II. What a profitable war people could wage saving lives—if they would—and how relatively cheap!

DIAMOND ALKALI CHEMICALS ®

Chemicals you live by ... DIAMOND ALKALI COMPANY CLEVELAND, OHIO

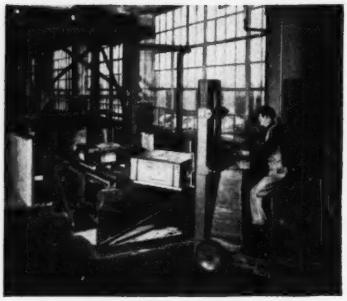
SODA ASH • CAUSTIC SODA • CHLORINE & DERIVATIVES • BICARBONATE OF SODA • SILICATES • CALCIUM COMPOUNDS • CHROME COMPOUNDS • ALKALI SPECIALTIES

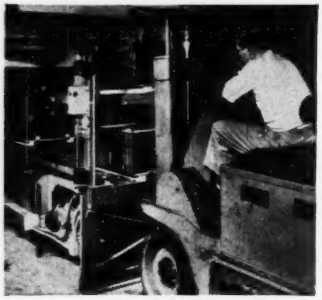
only through *Engineering* can *Efficiency* be achieved...

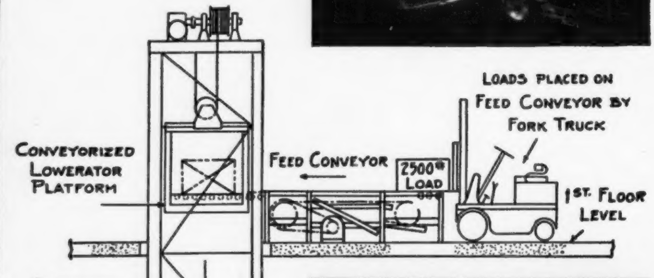
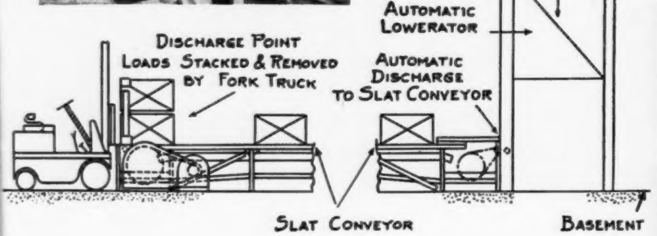
Up 87½%

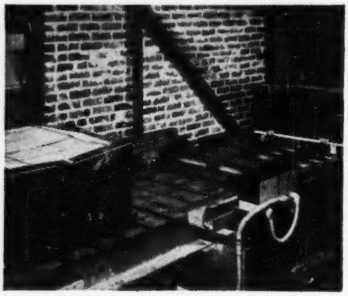
for department of a

LARGE EASTERN CAN COMPANY*







Like many foresighted manufacturing companies of today, this large eastern can manufacturing company, is constantly aware of in-plant materials handling as a major operating cost. The diagram and pictures present Gifford-Wood's solution to their problem of handling materials to storage. Long, empty return runs of the fork trucks used was only one aspect of the previous method of operation which was unduly expensive. Through the new G-W System, 2500-lb. bundles of steel sheets which formerly required eight hours to unload and store are now handled in one!

Working with Wigton-Abbott Corporation, Consulting Engineers, Gifford-Wood applied the materials handling knowledge for the solution of a costly problem—and this is only typical of many such engineered installations. All elements of such an installation (length of horizontal conveyor travel, raising or lowering to floors above or below, etc.) are, of course, designed to best suit the particular conditions encountered.

The G-W Materials Handling Engineer in your area will be glad to discuss the most economical means of materials flow in your plant. Call on him—it may well be the first step toward higher profits through lower operating and maintenance costs.

***Company name available on request.**

GIFFORD-WOOD CO.

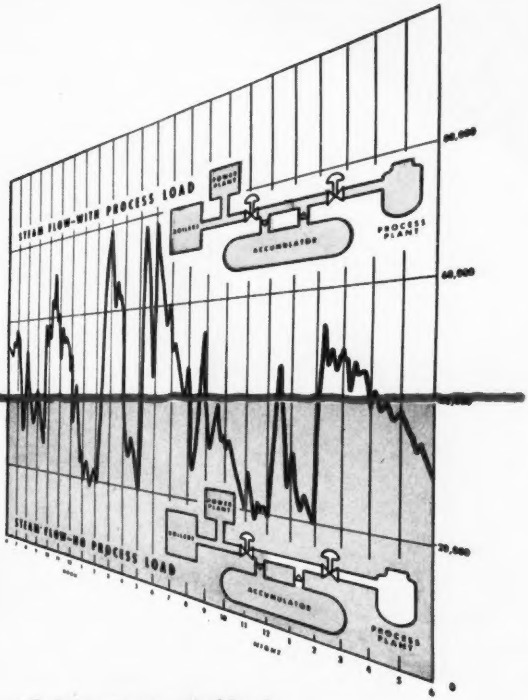
Since 1814 • Hudson, New York

NEW YORK 17, N. Y. 420 LEXINGTON AVE. — ST. LOUIS 1, MO. RAILWAY EXCHANGE BLDG. — CHICAGO 6, ILL. 565 W. WASHINGTON ST.

When you think of materials handling—Think of Gifford-Wood

8387

balancing steam supply and demand



economically—automatically with the FOSTER WHEELER ACCUMULATOR

Now you can operate your boilers at their most *economical* level, and *automatically* supply constant-rate, high-pressure steam to your power plant *plus* steam for the severe fluctuating needs of your process departments.

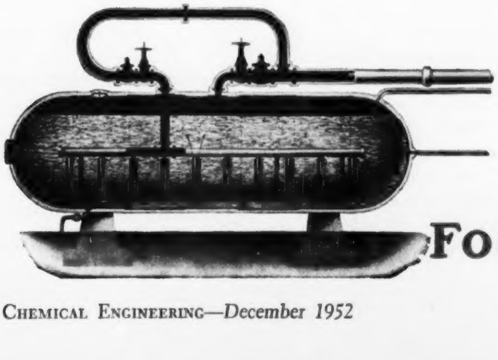
The Foster Wheeler Steam Accumulator automatically takes the "swings" of intermittent high-steam demand by storing the heat energy of steam in a large quantity of water under pressure, and at saturation temperature, and releasing the energy in the form of steam at a lower pressure. Thus, with the boiler plant operating at its most economical constant rate, the accumulator will receive, condense and store steam during periods of low process-plant demand and return it to the steam lines during periods of high demand in the processing departments.

REDUCES REQUIRED BOILER CAPACITY

In plants without an accumulator, boiler capacity to meet peak process loads may need to be double the average load. However, where an accumulator is installed, boiler capacity need only be sufficient to meet the average load. Thus a reduction is made possible in the size or number of boilers required.

INCREASES BOILER EFFICIENCY

The constant load at which the boilers operate in conjunction with an accumulator, plus the ability of the accumulator to supply all peak demands, assures constant steam pressure, maximum efficiency and capacity in both power generation and process work.



Each Foster Wheeler Accumulator is designed to meet the particular requirements in your plant. Installations have been made as small as 200 cu. ft. and as large as 176,000 cu. ft. Send us the details of your problem today. Write to:

FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

Possible applications for FIBERFRAX fiber

THERMAL INSULATION

- Used loose, bonded, packed, or as a blanket for insulating furnaces, jet engines, etc.
- Tape for wrapping pipes and other parts requiring high temperature insulation.
- Fireproofing for safes and containers.
- Packing for expansion joints, kiln cars, etc.
- As a paper, fire curtain, or bonded into a fire wall.

REINFORCING AGENT

- To reinforce electrical insulators, battery plates, etc.
- As a base for sprayed-on ceramic coatings.
- With resins to produce fiber-plastic materials.
- With deposited metals to make porous structures.
- In brake linings.

AS A FILTER

- To filter gases (can be burned clean and reused).
- Filtration of liquids (oils, acids, etc.).
- Flame filter to remove ash (as in gas turbine).

MISCELLANEOUS

- As a wick or other capillary body.
- Cushioning or vibration dampening material.
- Bonded into acoustical tiles.
- As a diffusing material (high corrosion resistance).
- As a catalyst support.
- For dielectric materials.

This listing does not represent all possible uses. These are simply suggested applications, many of which are untried.

versatile ceramic fiber—insulates, makes superfine filter, resists 2300°F (and more)!

This cotton-like material is a ceramic fiber, a new synthetic with a host of interesting possibilities. Brand new, this remarkable fiber (trademarked FIBERFRAX) easily withstands 2300 F without loss of properties, and up to 3000 F without melting — temperatures far higher than possible with existing mineral or glass fibers. Applications already tested range from — use as a superfine filter (even fine enough to filter bacteria) — to insulating blankets for combustion and exhaust systems of jet engines — to dielectric papers (with electrical losses ¼ those of Kraft paper).

FIBERFRAX fiber is made by melting aluminum oxide and silica (both non-critical materials) at 3300 F. The molten mix is then poured and blasted with an air jet. Instantly, a mass of fluffy white fibers is formed. These fibers are as long as 3″, yet average only 4 microns in diameter (about 1/25 the diameter of a human hair). Weight, as blown, is just 2 lbs per cu ft.

This random mass of fibers has many talents. Experimentally, it has been bonded into batts, made into felted rolls or blankets, and even made in paperlike forms (such as tape). When packed to density of about 6 lbs per cu ft, it can make a better heat insulator for many furnaces than high grade insulating brick. Because of its pronounced capillary qualities, it seems suitable for use as a wick. FIBERFRAX fiber is also virtually impervious to most acids. It could be used as a catalyst carrier. And it seems a natural substitute for asbestos — or it could be combined with this rather critical material.

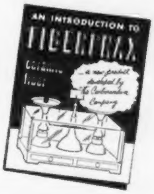
Inherently an excellent electrical insulator, FIBERFRAX fiber will find many dielectric applications. It also lends itself to use as a reinforcing agent — for example, in battery plates, or in low pressure laminates, or perhaps as a base for sprayed on ceramics. It is resilient and makes a good cushioning or packing material, particularly for high temperature spots. It could be used for fire proofing, or bonded into a firewall. FIBERFRAX tiles also deaden sounds. In bulk or paper form it makes an unparalleled filter for gases, liquids, flames, etc.

Do any of these applications suggest possibilities to you? If so, please write or phone us. Though FIBERFRAX fiber is presently available only in bulk form, all the forms mentioned here (and perhaps others) will soon be commercially available. Why not check up now?

CARBORUNDUM

Trade Mark

"Carborundum" and "Fiberfrax" are trademarks which indicate manufacture by The Carborundum Company



FIBERFRAX material magnified 500 times. Note the diverse size and random arrangement of fibers (ideal properties for a filter material).

FOR COMPLETE INFORMATION — USE THIS COUPON

Dept. H-122, Refractories Division
The Carborundum Co., Perth Amboy, N. J.

Please send free folder on FIBERFRAX fiber.

Name____________________

Position__________ Company__________

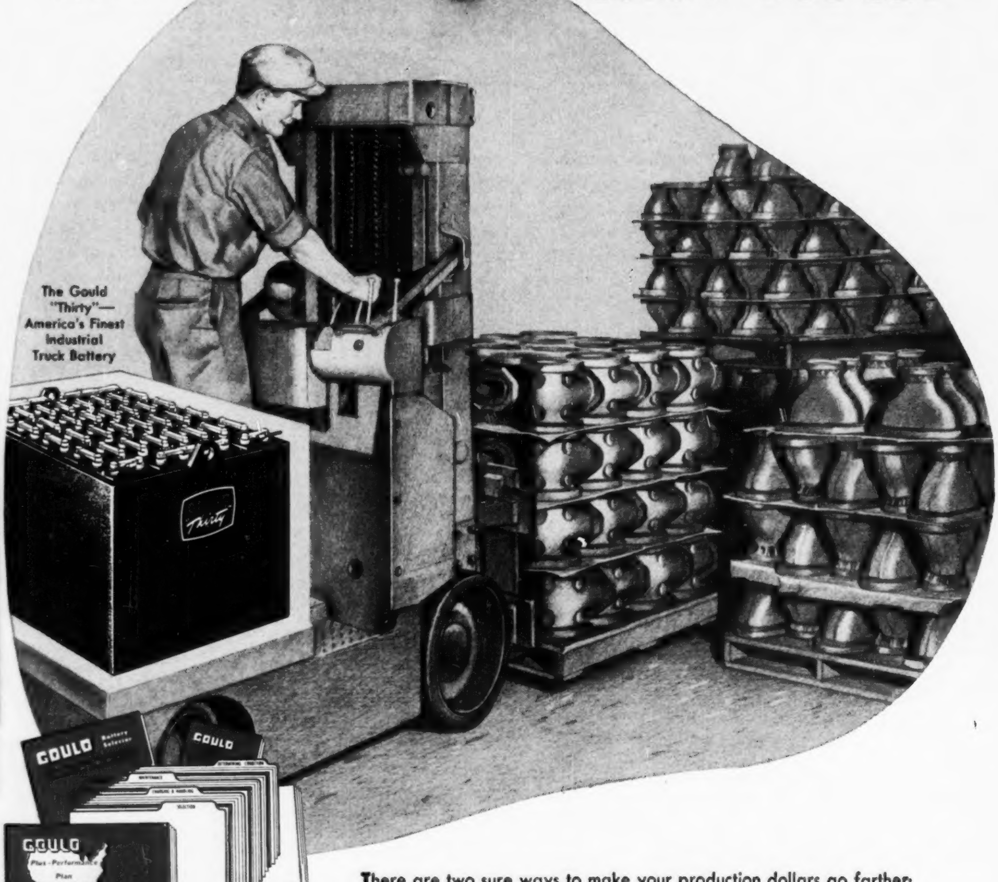
Street____________________

City__________ Zone____ State____

HOW TO

SQUEEZE MORE DOLLARS

OUT OF YOUR PRODUCTION BUDGET



THE GOULD PLUS-PERFORMANCE PLAN—A library of technical information that tells you how to select, charge, maintain and determine the condition of lead-acid batteries. It's free. Write Gould Battery Information Headquarters.

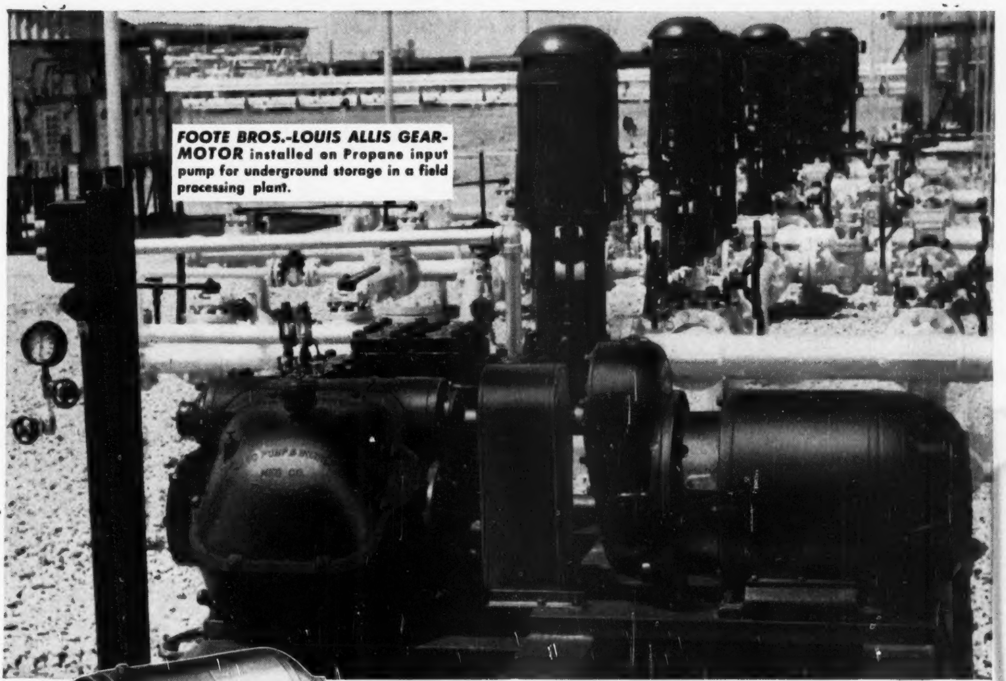
There are two sure ways to make your production dollars go farther:
1) Power your industrial trucks with Gould "Thirty" Batteries;
2) Maintain *all* your batteries, regardless of make, with the Gould Plus-Performance Plan described at the left.

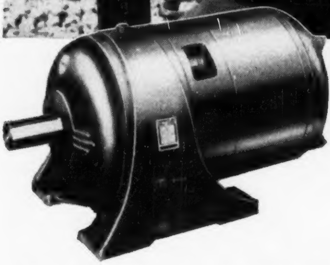
Here is complete assurance of maximum battery performance throughout longest possible service life. For real materials handling economy, take advantage of this cost-cutting combination . . . write for full information on Gould "Thirty" Batteries and the Plus-Performance Plan.

GOULD *Industrial Batteries*

GOULD-NATIONAL BATTERIES, INC., TRENTON 7, N. J.

Always Use Gould-National Automobile and Truck Batteries





When the Going's Tough

IT'S FOOTE BROS-LOUIS ALLIS GEARMOTORS FOR SERVICE

Out in the oil fields, there's no time to "baby" equipment. Quality counts and quality must be coupled with the rugged, sturdy ability to stand up under day-in and day-out service.

It is on jobs like these that the inherent stamina — the high quality — of Foote Bros.-Louis Allis Gearmotors prove themselves.

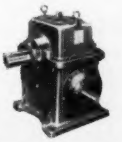
Compact in design, quality built throughout, these gearmotors incorporate Duti-Rated Gears with file-hard surfaces and resilient cores. The cast iron housings give rigidity, and the large oil reservoir with splash lubrication means continuous trouble-free operation.

Foote Bros.-Louis Allis Gearmotors are available in single, double, and triple reductions, to provide output speeds of 780 down to 7.5 r.p.m. and capacities from 1 h.p. through 150 h.p. Open drip-proof, splash-proof, enclosed and explosion-proof motor enclosures are available.

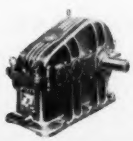
FOOTE BROS.

Better Power Transmission Through Better Gears

LINE-O-POWER DRIVES



HYGRADE DRIVES



MAXI-POWER DRIVES

Foote Bros. Gear and Machine Corporation
4545 S. Western Boulevard
Chicago 9, Illinois

Please send me Bulletin GMA containing full information on Foote Bros.-Louis Allis Gearmotors.

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Company..

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Position..

City.............................. Zone........ State..........

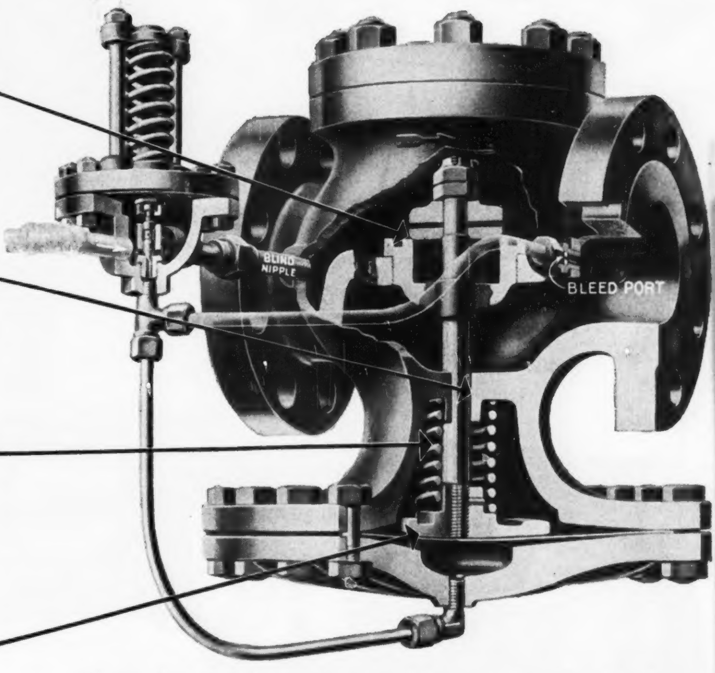
WHY Spence Regulators Outlast The Field

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. More than *twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.



Spence Type EQ back pressure regulator-operation of main valve is controlled by a sensitive pilot to regulate the initial pressure. Same pilot is used with all sizes of main valves.

The features shown above explain why you profit on every important count with Spence Pressure and Temperature Regulators.

Learn more about these and many other advantages of Spence Regulators by sending for Bulletin 350.

DURABILITY Spence Regulators perform dependably year after year.

ACCURACY You can be sure of accurate control for the life of the regulator.

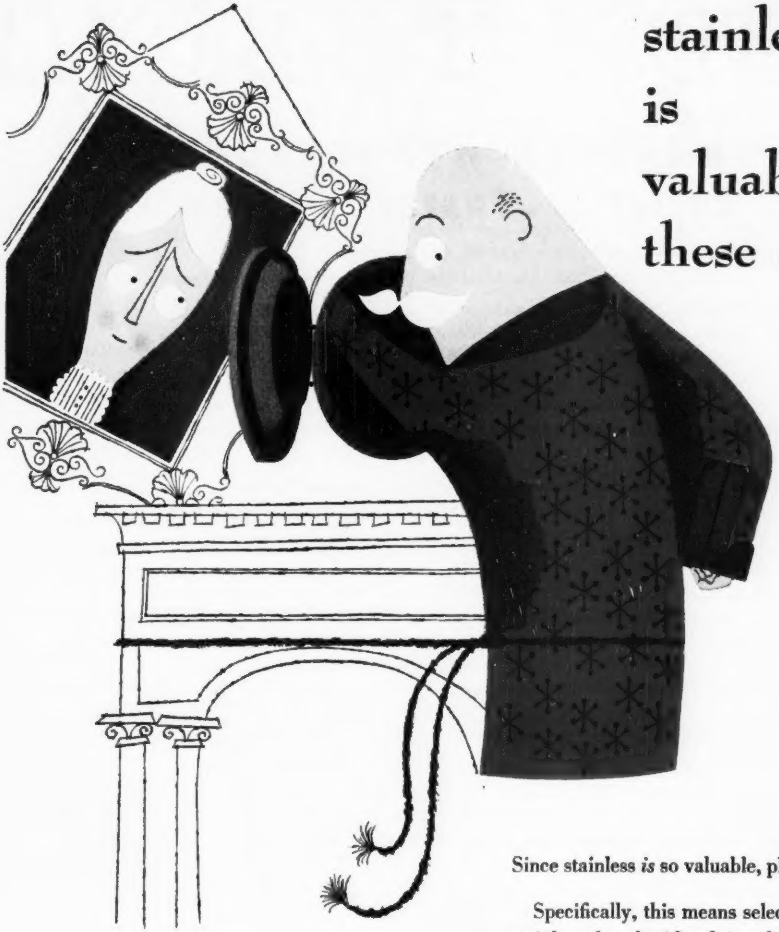
MAINTENANCE You don't need expensive repairs or special maintenance. That means less down-time, less time and money wasted on replacement of parts.

SE-110

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

Spence

stainless is valuable these days



Since stainless *is* so valuable, plan to make it go further.

Specifically, this means selecting a grade or finish of stainless that, besides doing the job adequately, will be in less demand than one you have been figuring on.

Here is where Crucible can help you out. The matchless experience of our metallurgists and stainless fabricating specialists can help you get the most out of your share of stainless.

Call upon us to help you.

CRUCIBLE first name in special purpose steels

52 *years of* Fine *steelmaking*

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TYGON *flexible plastic* TUBING

HANDLES HYPOCHLORITE
Easier . . . Faster . . . Longer

• Here's a perfect example of how large bore TYGON Tubing solved a tough chemicals handling problem and solved it well!

• Arden Chemical Co. manufactures and distributes laundry bleach. The concentrated sodium hypochlorite solution (over 15% available chlorine) is sold in bulk to laundries and to other companies who dilute and repackage it for sale as "Javelle Water." Seven tank trucks haul the bulk solution from plant to plant. The hose used to transfer the material from trucks to storage tanks presented the real problem.

• Metal reinforced rubber hose was first used. The bleach attacked the rubber quickly—caused failure in a matter of months. Repairing and replacement was costly and frequent. And, equally important, the reinforcement made the hose heavy, stiff, and hard to handle.

• Then, large bore TYGON Tubing (1½" ID x 2" OD) was tried. It was completely successful. The hypochlorite had no effect. The hose was much lighter (⅓ as heavy), much more flexible, infinitely easier to handle. TYGON's clarity permitted full solution visibility. Its smooth surfaces gave maximum flow and easy cleaning. Today, all seven trucks are equipped with TYGON and each hose is as good as new after more than a year's service.

• Why not look into TYGON as the solution to your materials handling problems, today? TYGON goes from anywhere to anywhere — quickly and easily. It handles acids, alkalies, oils, most solvents, water and corrosive gases — safely and efficiently. Ask for our Bulletin T-77 for the full story.

• PLASTICS AND SYNTHETICS DIVISION •

54-D

THE UNITED STATES STONEWARE CO. • AKRON 9, OHIO

THE *Chementator*

Reg. U.S. Pat. Off.

Prepared under the editorial direction of Joseph A. O'Connor, News Editor

Ammonia by partial oxidation

Significantly, Spencer Chemical Co. will produce anhydrous ammonia at its new Vicksburg, Miss., plant, not by the steam-methane process, but by the new partial oxidation process. The Vicksburg plant is expected to be completed by the fall of 1953.

Spencer decided on partial oxidation because it appears to be more economical than the more commonly used steam-methane process. At the same time, it opens for Spencer broad possibilities in the partial oxidation of a variety of fuels and in the utilization of tonnage oxygen.

How much for chemical plants in 1953?

Chemical manufacturers plan to spend about $1,301,000,000 for new plants and equipment in 1953, down 13 percent from 1952, when capital outlay came to $1,503,000,000.

The chemical industry expanded so rapidly in 1952 that, even if certain markets for chemicals continue to grow, there won't be the need to add capacity at such a pace.

Cutbacks in expansion plans of rayon makers pulled down the 1953 capital outlay anticipated by the chemical industry. For manufacturers of industrial chemicals the drop in planned spending averages less than 10 percent.

Petroleum companies plan to spend more for new wells, pipelines and refineries in 1953, partly because their spending lagged in 1952. The oil companies expect to shell out $2,967,000,000 in the year ahead, up 5 percent from the $2,812,000,000 they spent in 1952.

Capital expenditures for all manufacturing industries, embracing most of the large companies, will add up to about $11,753,000,000 in the coming year, about 8 percent less than the $12,808,000,000 they invested in plants and equipment during 1952 but more than they spent in 1951. However, part of the increase over 1951's $11,130,000,000 outlay reflects higher costs.

Big companies, financially stronger and getting more of the fast tax writeoffs on defense plants, are keeping up total capital expenditures by their heavy spending. Smaller companies are cutting down.

Unless the smaller companies step up expansion, industry leaders will increase their competitive advantage by acquiring more modern plants and equipment.

Most large manufacturers are already planning expenditures as far ahead as 1955. For 1953, these plans are now being firmed up. But a downturn in business during 1953 might postpone capital spending in the year ahead. Expansion would not be abandoned, but it would be stretched out.

NPA lifts controls on use of sulphur

NPA has lifted restrictions on sulphur consumption in the United States. Previously consumers had been limited to 90 percent of the amount they used in 1950, plus added allowances for essential needs.

Government estimates now show U.S. supply of sulphur in all forms exceeding U.S. consumption plus exports by 434,000 long tons in 1952 and 363,000 tons in 1953.

Supply in 1952 reached 6,524,000 tons against consumption plus exports of 6,090,000 tons. Next year, supply will reach an estimated 7 million tons against consumption and exports expected to come to 6,637,000 tons. Four-fifths of the supply is brimstone mined from Gulf Coast salt dome deposits.

"Now that we again have sufficient sulphur to meet the demand," declares President Langbourne M. Williams, Jr., of Freeport Sulphur, "the controls on consumption no longer are necessary. NPA has acted promptly and wisely in removing them. This action constitutes an important step toward the return of a free economy."

In July, Williams had pointed out that supply and demand were virtually in balance in the United States, that the situation abroad had also improved and that the outlook ahead was encouraging. In August, NPA relaxed restrictions on consumer inventories.

The present removal of controls on U.S. consumption leaves price and export controls on sulphur still in effect.

Chemical industry comes to readiness

The chemical industry is now ready for any national emergency that may arise, according to three of the nation's top chemical leaders in industry and government. What's more, they expect the industry's record-breaking expansion to continue with little let-up.

Expansion of the chemical industry over the past two years is unparalleled in the nation's history, declares

(*Continued on page 104*)

Dr. George E. Holbrook, former head of NPA's Chemical Division. The industry's four-year program, which calls for expenditures exceeding $5 billion by 1955, is surpassed only by the expansion plan of the steel industry.

Dr. Robert C. Swain, vice president of American Cyanamid, sees no reason for the present rate of expansion in chemicals to stop. Prophets who say the industry is overextending itself were wrong in 1946, and they will be wrong again, he predicts.

"The chemical industry must be dynamic in self defense," Swain says. "Many times in the past a competent, well-run chemical company has found itself virtually put out of business overnight by a cheaper process developed by one of its competitors. We must stay dynamic in order to survive."

Declaring that "The industry has now met all the requirements for the present defense program," Vice President Dan M. Rugg of Koppers points out that World War II accelerated requirements for chemicals, and laid the groundwork for much present growth.

As for the chemical industry's readiness to meet any emergency, Holbrook says, "I believe that the chemical industry is much more competent now than ever before to find alternate raw materials to replace those that might be cut off in the event of an international crisis.

"I also feel," Holbrook adds, "that the industry is definitely better prepared to grapple with difficult technical problems, and I believe we can even say the world leadership in chemistry and chemical engineering now is really a keystone in the industrial strength of the United States."

High-velocity reactions use jet principles

Totally new thermodynamic concepts, resulting from aerodynamic research on rockets and ram jets, are now being brought to bear on design of radically new equipment for the chemical process industries. Result: far-reaching advances in control of high-temperature reactions at high velocities—often higher than sonic.

A new high-velocity burner using the principle of the ram jet has been developed by Thermal Research & Engineering Corp. of Conshohocken, Pa. It completely vaporizes and burns gas or liquid fuels, releasing from 1 million to over 10 million Btu. per hr. per cu. ft. of combustion volume. Completely burned products emerge at velocities that provide convection heat transfer rates never before possible. The burner can be used in boilers, heat exchangers, drying and processing equipment. It will be important in high-temperature reactions.

The burner is used in a new acetylene process that Experiment Inc. of Richmond is working on for Chemical Construction. Du Pont is trying it in burning titanium tetrachloride. Glass makers are exploring its use in submerged combustion processes. Chemical Conversion Inc. of Chicago is negotiating with big steel companies on a submerged combustion method for recovering pickle liquor. Carbide at Institute, W. Va., uses the burner to dispose of fly ash and Du Pont is trying it in a spray drying operation.

Europe plans atomic research

Ten European nations will be asked to contribute sums ranging from $500,000 to $5 million each to build a $25 million atomic research center near Geneva, Switzerland. The laboratory, originally sponsored by the United Nations Economic, Scientific and Cultural Organization, would be jointly owned by the companies paying for it.

Representatives of the 10 European nations, acting as the European Council for Nuclear Research, have asked their countries to put up the money. The nations involved: France, West Germany, Denmark, Switzerland, the Netherlands, Norway, Italy, Belgium, Sweden and Yugoslavia.

Chemicals for synthetic rubber

Changes affecting supply and demand for chemicals used in rubber making are now occurring in the nation's synthetic rubber industry. The chemicals affected: butadiene, styrene, alcohol, benzene and other chemicals used in making copolymer or in compounding.

Manufacture of butadiene from alcohol is to be resumed immediately in two units at the government plant in Kobuta, Pa. Production there should just be getting into stride.

This unexpected switch in plans came about because the rubber industry, despite its use of considerable natural rubber, has actually been purchasing more synthetic rubber from the government than anticipated. Surprisingly too, the industry has been taking more regular GR-S and less cold rubber than expected. Apparently, low-grade natural rubber is being used instead of cold rubber.

Production of butadiene from alcohol means that alcohol now held by the RFC must be used for this purpose. If RFC builds up its inventory this winter, the move might stiffen the price of industrial alcohol.

The supply of butadiene for synthetic rubber will thus be increased without depriving industry of that chemical for other uses. Recently the maximum quantity of synthetic rubber that could be produced has depended on how much butadiene was available.

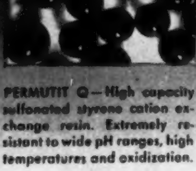
RFC is completing plans for construction of added capacity to produce butadiene from petroleum in government plants. When these plants are completed, perhaps by mid-1953, manufacture of butadiene from alcohol might be discontinued, but that isn't certain.

Keeping the styrene supply and demand in balance is difficult, but it's being done. Obviously, more

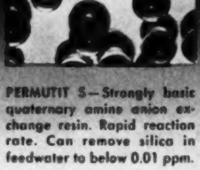
(*Continued on page* 108)

ION EXCHANGE RESINS BY PERMUTIT TO

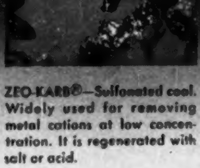
SOME OF PERMUTIT'S FAMILY



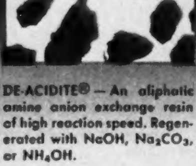
PERMUTIT Q—High capacity sulfonated styrene cation exchange resin. Extremely resistant to wide pH ranges, high temperatures and oxidization.



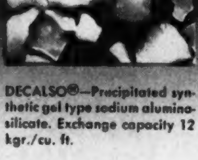
PERMUTIT S—Strongly basic quaternary amine anion exchange resin. Rapid reaction rate. Can remove silica in feedwater to below 0.01 ppm.



ZEO-KARB®—Sulfonated coal. Widely used for removing metal cations at low concentration. It is regenerated with salt or acid.

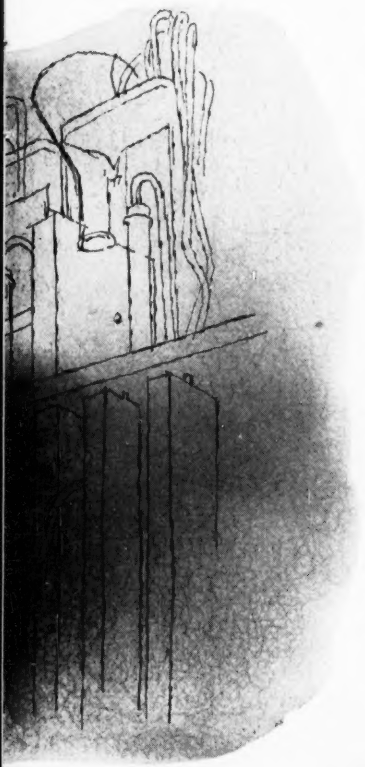


DE-ACIDITE®—An aliphatic amine anion exchange resin of high reaction speed. Regenerated with NaOH, Na_2CO_3, or NH_4OH.



DECALSO®—Precipitated synthetic gel type sodium alumino-silicate. Exchange capacity 12 kgr./cu. ft.

MADE TO ORDER
FIT YOUR SPECIAL NEEDS



Maybe you've checked ion exchange resins only to find that none of them seem to do your special job exactly the way you want it done.

Exchange or backwash rates are too low. Or you find that under your particular operating conditions initial resin capacities slack off. Or high temperature and pH tend to shorten their life. Or large molecules do not exchange satisfactorily.

If that's the case, don't feel you have to settle for a "misfit" resin. Come to Permutit. Tell us exactly what you expect from an ion exchange resin. What you want it to do. How you want it to behave. We'll make it to your exact specifications. You'll get the perfect resin for your special needs.

More than 40 years of intensive research and practical application have made The Permutit Company headquarters for ion exchange resins and equipment. Way back in 1912 Permutit pioneered the application of ion exchange to the treatment of water and our skill has increased steadily ever since.

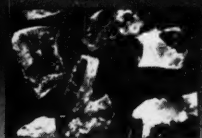
Below are a few of our most widely used ion exchangers. If you'd like to test them before discussing with us a made-to-order resin, we'll be happy to send you samples. And, of course, we'll be just as pleased to send you further information concerning any phase of ion exchange.

Just write to THE PERMUTIT COMPANY, DEPT. CE-12, 330 WEST 42ND STREET, NEW YORK 36, N.Y., or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

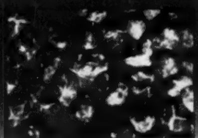
ION EXCHANGE HEADQUARTERS FOR OVER 40 YEARS

PERMUTIT®

OF ION EXCHANGERS...

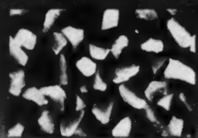


PERMUTIT A—Moderately basic anion exchange resin to remove weak acids from solutions. Regenerated with sodium hydroxide.

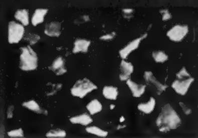


ZEO-DUR®—Processed glauconite (naturally occuring greensand). It is rugged, rapid, long-lived and is regenerated with salt.

PERMUTIT H-70—Very high exchange capacity carboxylic acid resin. Used for separation of amino acids, alkaloids, antibiotics, etc.



PERMUTIT FOLIN—Modification of Decalso, used in laboratories for determining ammonia by the Folin method.



PERMUTIT Ag — Used in Permutit Seawater Desalting Kit. By shaking for 20 minutes a good desalted drinking water is produced.

styrene will be needed as synthetic rubber production mounts, whether standard GR-S or cold rubber is produced.

Chemicals used in copolymer making or for compounding will continue in demand. However, consumption will be less than peak requirements of recent years.

When the added butadiene capacity is completed, the government will possess facilities for manufacture of raw materials and copolymer plants capable of turning out 860,000 long tons per year of regular GR-S and cold rubber combined.

While three-quarters of this capacity will be able to produce cold rubber, it's expected that soon about equal quantities of regular GR-S and cold rubber will actually be made.

Total industry requirements for synthetic rubber will come to 600,000 or 650,000 long tons per year. Natural rubber will meet the balance of the industry's requirements for its present high level of operation.

The rate of stockpiling has been disappointing RFC officials. For example, in one month when it was expected that 7,000 tons of cold rubber could be put into inventory, ultimately for the stockpile, the actual result that month was a 7,000-ton dip in the inventory. Until recently this continuing consumption of cold rubber and likewise the increasing demand for regular GR-S could not be foreseen even in the industry. But now forecasts point to continued high use of synthetic rubber through most of the winter and perhaps longer.

Adding rosin improves synthetic rubber

A new synthetic rubber, developed by U. S. Rubber and now in the pilot-plant stage, promises greater tire wear when it becomes a commercial product. It's made by adding rosin chemicals to an extra tough cold type of GR-S.

The new rubber is 30 to 50 percent more abrasion resistant than standard cold rubber. It has up to 30 percent higher tensile strength at room and elevated temperatures. It is heat resistant; its temperature rise on flexing is 10 to 15 deg. F. lower than that for regular cold rubber. It shows a five to tenfold increase in resistance to cracking caused by rapid flexing. It is likewise superior in its resistance to aging in air. Preliminary road tests with tires confirm laboratory results.

Rosin chemicals that can be used as extenders include wood rosin, disproportionated rosin, hydrogenated rosin, abietic acid and dimerized rosin. Soaps of these rosin chemicals are dissolved in warm water and added to the rubber while it is still in the latex or liquid form. This loads the butadiene-styrene copolymer with the required acid. Carbon black, the principal reinforcing agent for rubber, may also be added at the same time.

Pilot-plant quantities of the new rosin-extended rubber are being produced at the Naugatuck, Conn., plant of U. S. Rubber's Naugatuck Chemical Division, which is operated by U. S. Rubber for the RFC. The new rosin-extended rubber may ultimately prove cheaper and better than present oil-extended synthetic rubbers.

Canadian natural gas for Pacific Northwest

The Canadian Board of Transport Commissioners has finally approved a proposal to build a natural gas pipeline from the Peace River area of northern Alberta and British Columbia to Vancouver and the northwestern United States.

In Washington, the Federal Power Commission is expected to rule soon on United States authorization of the line. This is considered essential to its construction. Reason: the market for natural gas in British Columbia probably isn't big enough to justify the $111 million cost of the pipeline.

Natural gas reserves in the Peace River area are estimated at 2,506 billion cubic feet, enough to supply anticipated markets in both British Columbia and the United States for at least 25 years.

An oil pipeline from Alberta to the Pacific Northwest is already under construction. When completed in August 1953 it will stretch 711 mi. from Edmonton to Vancouver.

Exports of Canadian oil to the Pacific coast of the United States are expected to find a ready market. Increased industrial and defense requirements have drawn heavily on U. S. oil supplies in the Pacific Northwest.

Newsprint situation in the West

Production and consumption of newsprint in the western part of the United States and Canada could rise more than one-third above the present rate in the next decade, according to Stanford Research Institute.

By 1961 western users of newsprint will require 35 percent more than presently, as contrasted with an 18 percent rise in national consumption.

Western regional production is expected to increase about 39 percent in the same period. Supply should keep abreast of demand until the late '50s if newsprint imports continue at current levels and present mills expand as planned.

Last year western producers marketed about 93 percent of their output in their own territory.

No actual shortage of newsprint is foreseen, although consumers may not always be able to get all they want during the next decade at prices they can afford.

Could another big newsprint mill be built in the West without creating an oversupply in the region? A mill to supply the western market might profitably be built under certain circumstances in a selected location, but the investment required would be high, accord-

(*Continued on page* 110)

ing to SRI economists. And it's not altogether unlikely that a major new mill might cut into the market for newsprint from other sources.

Bigger refineries for Australia

Petroleum companies plan to spend $184.5 million in the next four years to boost oil refinery capacity in Australia. Four of the big outfits in the expansion will be Anglo-Iranian Oil Co., Caltex Oil, Vacuum Oil Co. and Shell Oil Co.

New way to rid sour crudes of sulphur

A new catalytic desulphurization process, now offered by M. W. Kellogg as a result of a licensing arrangement with the Anglo-Iranian Oil Co., Ltd., eliminates 90 percent of the sulphur in sour middle distillates without appreciable product loss.

Anglo-Iranian developed the process, known as Autofining, and has successfully carried it through the pilot-plant stage. Anglo-Iranian now uses the process not only in a semi-commercial unit with a capacity of 450 bbl. per day at its Grangemouth refinery in Scotland but also in a 3,500 bbl. per day plant at its Llandarcy refinery in Wales.

Significance of Autofining arises from the growing use of high-sulphur crudes by U.S. refiners. Such crudes are produced in West Texas and the Rocky Mountain fields; they are also imported from the Middle East and South America. To produce jet fuels, heating oils, kerosene, diesel oil and tractor distillate, the middle distillates from all these crudes must be desulphurized.

Sulphuric acid refining eliminates enough of the sulphur, but sludge forms in the process, cutting yields to 90 percent or even lower. With the Autofining process, refiners get virtually a 100 percent volumetric yield of middle distillates. They save the cost of acid and there's no problem of waste disposal.

Initial cost of an Autofining unit is appreciably less than that of a conventional desulphurizing plant, according to Anglo-Iranian. Regeneration of the low-cost catalyst is usually required only about once a month, and the catalyst lasts about five years. The new process requires no hydrogen from other sources. Using heavier feedstocks than conventional processes, it makes possible more complete desulphurization.

While Autofining is especially important to refiners aiming at maximum production of middle distillates, its implications for U.S. producers of gasoline may also be great. This is particularly true of refiners who are finding they must process more sour crudes to meet the ever expanding demand for gasoline.

Its potential importance in jet fuel production is likewise apparent. Today, most jet fuel comes from sweet crudes, but the market is growing steadily, and a full-scale war would immediately force refiners to use other crudes and mixtures of crudes. The demand could never be met without increased use of desulphurization.

Uranium from gold ores by ion exchange

South Africa's first uranium extraction plant is now getting uranium from ore residues at the gold mine of West Rand Consolidated Mines near Krugersdorp. Similar plants will soon be operating at other gold mines, heralding a new economic era for South Africa. The uranium is extracted by an ion exchange process developed for AEC by companies in the United States, among them Permutit and Dow.

The new plants at the gold mines will manufacture their own sulphuric acid, largely used in the uranium extraction. Pyrite, also extracted from the gold ores, can be used to make sulphuric.

An outlay of more than $112 million is planned to build a string of these plants at gold mines in South Africa. So far, 13 gold mines have been picked for uranium production.

At full production, the new extraction plants will annually produce uranium valued at more than $84 million, earning foreign exchange for South Africa. The United States and Britain, purchasers of the uranium, are furnishing the capital to build the extraction plants.

New pharmaceuticals from amino products

Slowly but surely, International Minerals & Chemical Corp. is developing pharmaceutical markets for amino products. So far, only one is commercial. That's tyrosine, now undergoing market development. It's presently being used to treat such allergies as hayfever and asthma.

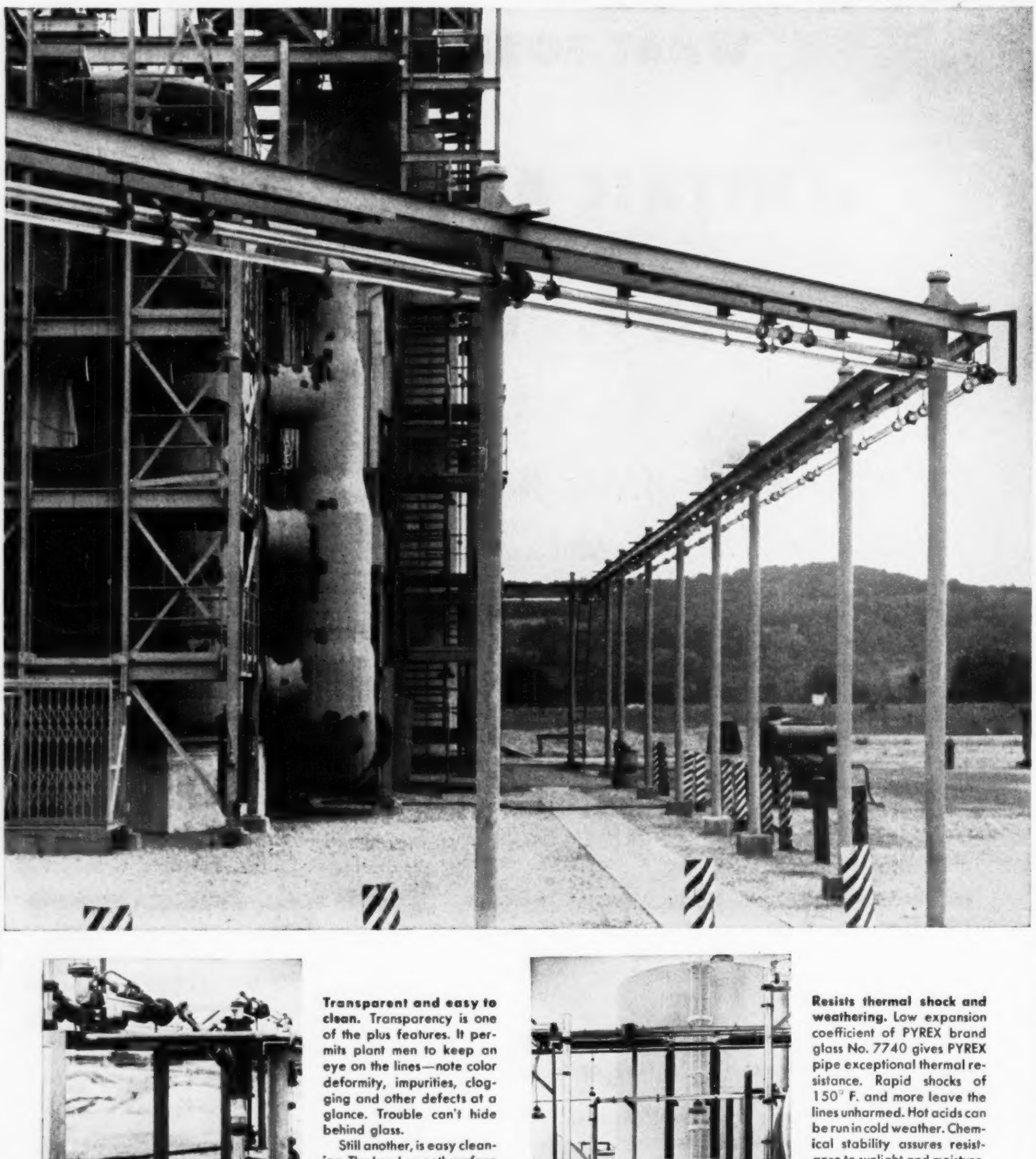
However, International is greatly upset over unauthorized and premature claims made for another amino product it is investigating. A combination of betaine and glycocyamine, this product is still undergoing clinical testing in the treatment of certain degenerative diseases. IM&C is making no claims for it yet.

Betaine itself is gaining as a lipotrope, helping in the proper utilization of fats. It's marketed by the Stewart Co. of Pasadena.

Glutamates can also take the place of salt in non-sodium and salt-free diets. Monopotassium glutamate is sold by Adolph Food Products of Los Angeles as a substitute for salt. Monoammonium glutamate, another salt substitute, is made and marketed by other glutamate producers, including General Mills and Huron Milling. Glutamic acid itself can take the place of salt. All of these glutamate products can replace sodium chloride or monosodium glutamate whenever salt or sodium must be avoided.

Glutamic acid hydrochloride is coming into use as a supplementary source of the hydrochloric acid required for digestion. *—End*

Acid corrosion of transfer lines no problem



Transparent and easy to clean. Transparency is one of the plus features. It permits plant men to keep an eye on the lines—note color deformity, impurities, clogging and other defects at a glance. Trouble can't hide behind glass.

Still another, is easy cleaning. The hard, smooth surface of PYREX pipe minimizes solids adherence, eliminates grooves and depressions where material might gather.

Resists thermal shock and weathering. Low expansion coefficient of PYREX brand glass No. 7740 gives PYREX pipe exceptional thermal resistance. Rapid shocks of 150° F. and more leave the lines unharmed. Hot acids can be run in cold weather. Chemical stability assures resistance to sunlight and moisture.

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at BAKELITE'S* Marietta plant

PYREX® brand "DOUBLE-TOUGH" GLASS PIPE is in the picture

In selecting a piping material for transferring acids at its Marietta, Ohio plant, Bakelite Company took several points into consideration. First cost was important. So was service life. This meant a piping material which would provide utmost resistance to acids day-after-day, year-after-year. Resistance to thermal shock and weathering was also important because the pipe was to be used outside in a climate known for its temperature extremes.

You can see how Bakelite solved its problems . . . with PYREX brand "Double-Tough" glass pipe. Not only was PYREX pipe low in first cost, extremely high in chemical and thermal resistance, but it offered several important extras, including transparency, easy cleaning, light weight and simple installation, together with exceptional mechanical strength.

**A Division of Union Carbide and Carbon Corporation*

Whether you are handling hot or cold concentrated acids (except hydrofluoric), mild alkalies or pharmaceuticals, you'll find PYREX pipe the safest and most economical material that you can use.

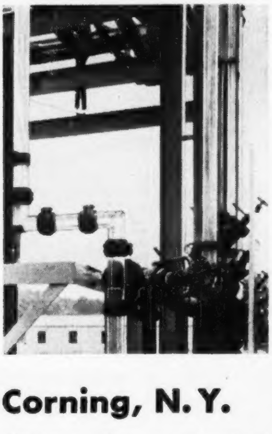
Readily available in many sizes

It is readily available in the following sizes—1", 1½", 2", 3", 4" and 6" inside diameters. A complete line of fittings including ells, tees, crosses, reducers, adapters, laterals, return bends and caps may be had. Glass plug valves are available in 1" and 1½" sizes. There are a wide variety of gaskets now in stock to resist virtually every chemical known. Light weight permits easy, economical installation with long lines. Your own plant help can do this job.

These PYREX brand glass pipe distributors stock the complete line:

- **ALBANY 5, NEW YORK** — A. J. Eckert Company
- **ATLANTA, GEORGIA** — Southern Scientific Company
- **BELMONT, CALIFORNIA** — Glass Engineering Laboratories
- **CAMBRIDGE 39, MASS.** — Macalaster Bicknell Company
- **CHICAGO 44, ILLINOIS** — Fred S. Hickey, Inc.
- **FRESNO 17, CALIFORNIA** — Valley Fdy. & Mach. Works
- **HATBORO, PENNSYLVANIA** — Sentinel Glass Company
- **ROCHESTER 3, NEW YORK** — Will Corporation
- **HOUSTON 7, TEXAS** — W. H. Curtin & Company
- **PITTSBURGH 19, PA.** — Fisher Scientific Company
- **MONTREAL 3, QUEBEC, CAN.** — Fisher Scientific Company, Ltd.
- **SEATTLE 4, WASHINGTON** — Scientific Supplies
- **ST. LOUIS 2, MISSOURI** — Stemmerich Supply Inc.
- **LODI, NEW JERSEY** — Mooney Brothers Corporation
- **BUFFALO 13, NEW YORK** — Buffalo Apparatus Corp.
- **NEW HAVEN, CONNECTICUT** — Macalaster Bicknell Company
- **NEW ORLEANS, LOUISIANA** — W. H. Curtin & Company
- **TORONTO, ONTARIO, CAN.** — Fisher Scientific Co., Ltd.
- **VANCOUVER, B. C.** — Scientific Supplies

PYREX brand "DOUBLE-TOUGH" Glass Pipe for drainage lines. A relatively new and rapidly spreading application for PYREX brand "DOUBLE-TOUGH" glass pipe is in draining corrosive wastes. Many plants have realized substantial savings because PYREX pipe virtually eliminates replacement problems. Then too, installation costs are lower because PYREX pipe does not require burial in concrete, and safety is greatly improved. Complete fittings (including sink traps) are available.



Mechanically strong. There's no need to worry about mechanical damage to PYREX pipe. First, it has proven over 25 years that it can take a beating. Second, ends and fittings (except U-bends) are tempered to double their strength. Third, plant men realize that it is glass and treat it with respect.

CORNING GLASS WORKS

Dept. CE-12, Corning, N. Y.

Please send me the printed information checked below:

- ☐ "PYREX brand Glass Pipe in the Process Industries" (EA-1)
- ☐ "PYREX brand "Double-Tough" Glass Pipe and Fittings" (EA-3)
- ☐ "Plant Equipment Glassware for Process Industries" (EB-1)
- ☐ "Installation Manual" for PYREX brand "Double-Tough" Glass Pipe (PE-3)
- ☐ "PYREX Cascade Coolers" (PE-8)

Name____________________

Title____________________

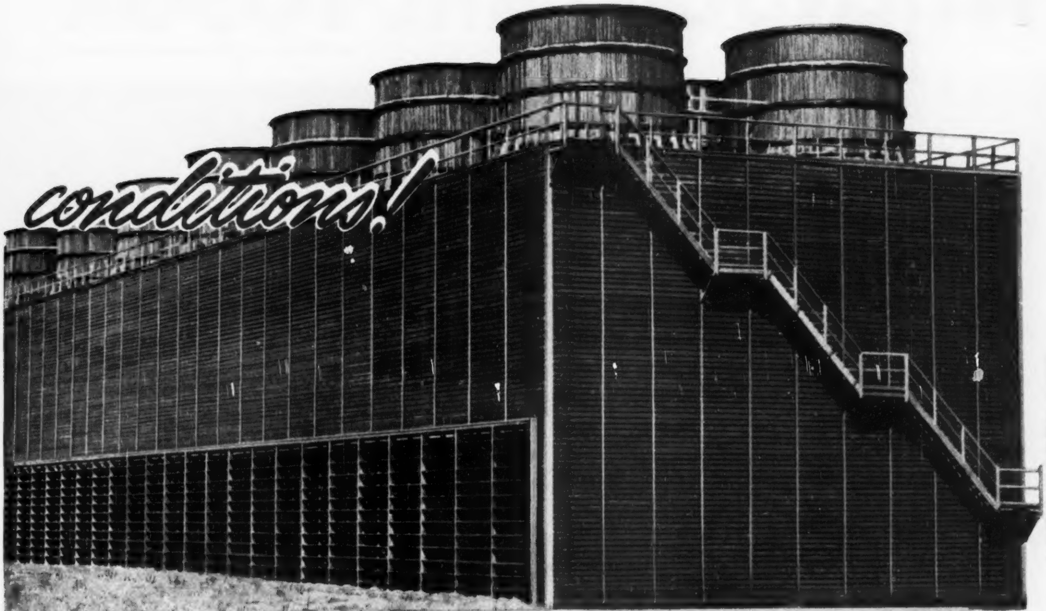
Company____________________

Street____________________

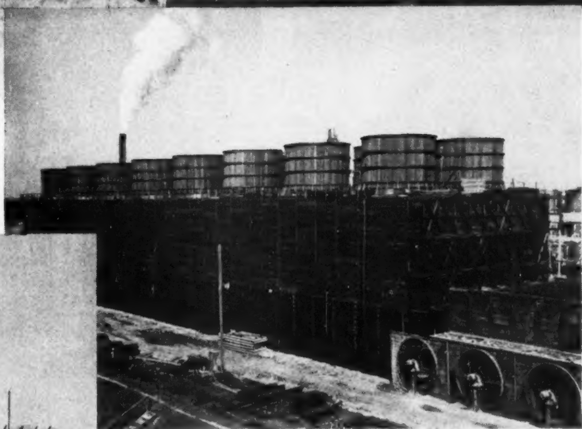
City____________________

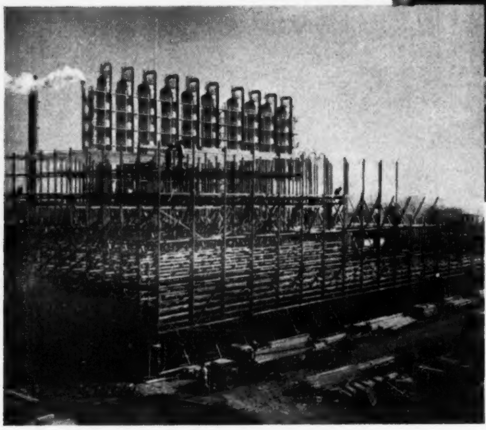
Zone________ State____________

Corning, N. Y. *Corning means research in Glass*



Completed tower for large Gulf Coast oil refinery, above. Progress photographs below. Note portion of old tower, still operating, in photograph at far right.





DESIGN CONDITIONS

Capacity	48,000 U.S. gpm
Inlet water temperature	120 F
Outlet water temperature	85 F
Wet bulb temperature	80 F

165 BROADWAY, NEW YORK 6, NEW YORK

FOSTER WHEELER

How would YOU solve these two problems?

POSITIVE BRAKE-ACTION, so essential to public safety, is aided by use of the Permafuse Corporation's special brake-bonding oven. Installed in progressive service stations, the Permafuse oven fuses the adhesive-coated brake lining to the brake shoe evenly and permanently. A low-cost, rugged THERMOSWITCH® unit keeps oven temperature constant for proper bonding and keeps service calls to a minimum.

PREVENTION OF SPOILAGE in refrigeration applications is a matter of constant, exact temperature control. In the Jewett Hospital Blood Bank, for example, temperature is maintained at 37°F within plus or minus 2 degrees. Two Fenwal THERMOSWITCH thermostats serve as an alarm device, warning instantly against freezing or refrigeration failure if temperature goes below 32° F or above 48° F.

A FENWAL THERMOSWITCH CONTROL may solve your problem, too. Its external, single-metal shell expands or contracts *instantly* with temperature changes, making or breaking enclosed electrical contacts. Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved hundreds of problems where heat is a factor.

SEND FOR THIS CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal, Incorporated, 1612 Pleasant Street, Ashland, Mass.

Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

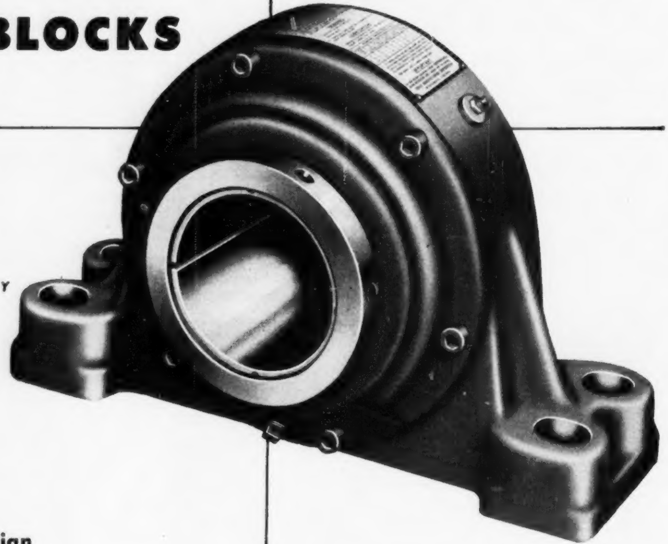
SENSITIVE . . . *but only to heat*

NEW

DODGE-TIMKEN ALL-STEEL PILLOW BLOCKS

HEAVY DUTY CAPACITY!

LESS SPACE! LESS WEIGHT!



A JOINT ENGINEERING DEVELOPMENT BY DODGE AND THE TIMKEN ROLLER BEARING COMPANY

- **All-Steel construction**
- **A new Timken bearing design**
- **High radial and thrust capacities**
- **Compact—minimum dimensions**
- **Minimum weight with maximum strength**
- **Fully self-aligning with spherical outer race**
- **Both expansion and non-expansion types**
- **Adapter mounting, proven through the years**
- **Double piston ring seals**
- **Sealed both on and off the shaft**
- **Fully assembled, permanently adjusted, lubricated and sealed at the factory**

Here are the bearings for industry's toughest jobs. High radial and thrust capacities. Stamina to take heavy shock loads. And all-steel construction packs this load-carrying capacity into less weight and less space. Engineers are already specifying "Dodge-Timken All-Steel" for some of America's largest projects. Write for details and delivery dates, or call your Dodge Distributor.

DODGE MANUFACTURING CORPORATION
200 Union Street, Mishawaka, Indiana

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new cost-saving methods. Look for his name under "Power Transmission Equipment" in your classified phone book.

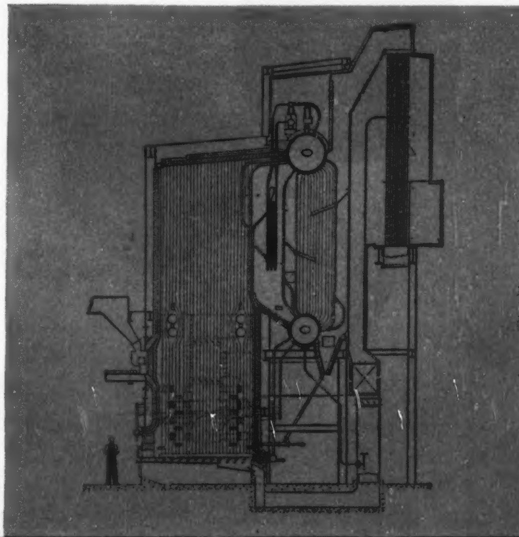
DODGE
of Mishawaka, Ind.

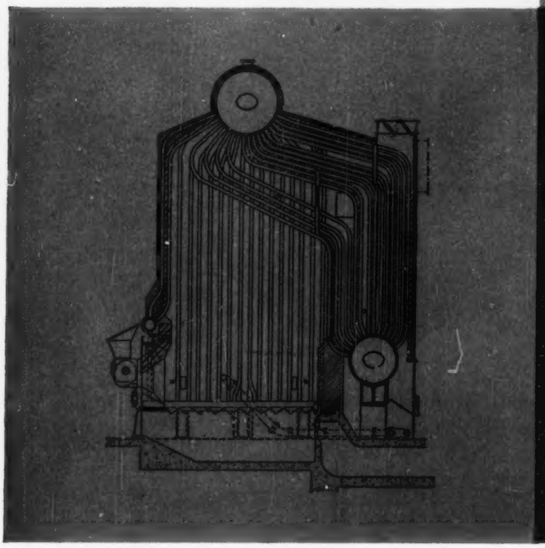
NAME PLATES — FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, CHICAGO THRIFT-ETCHING CORPORATION, 1555 SHEFFIELD AVENUE, CHICAGO 22, ILLINOIS

Leading Pulp and Paper Mills that have Purchased VU Units for One or more Plants

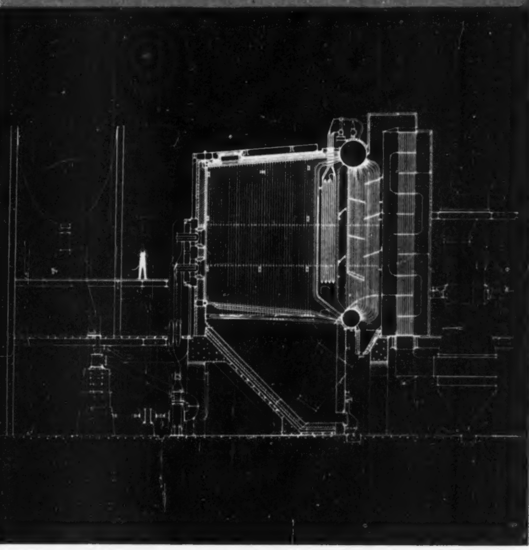
- The Brown Company
- Chesapeake Corporation
- Container Corp. of America
- Fraser Companies, Ltd.
- Robert Gair Company, Inc.
- International Paper Company
- Kimberly-Clark Corporation
- Macon Kraft Corporation
- Marathon Paper Mills of Canada, Ltd.
- National Container Corporation
- St. Regis Paper Company
- Scott Paper Company
- S. D. Warren Company
- Weyerhauser Timber Company

VU-50 Boiler — This unit, one of two duplicates, is installed at a West Coast mill. It is designed to burn hogged wood on a high-set spreader stoker. Capacity — 150,000 lb of steam per hr; operating pressure — 570 psi; steam temperature 675 F.





VU-10 Boiler, one of two in a Midwestern plant. Fired by coal, using a C-E Spreader Stoker. Capacity — 18,000 lb of steam per hr at 200 psi; no superheat. VU-10 capacities range from 10,000 to 60,000 lb of steam per hr.



VU-50 Boiler installed in a Southern mill. This boiler is fired with pulverized coal using C-E Raymond Bowl Mills. The capacity is 150,000 lb of steam per hr. Steam pressure is 865 psi — steam temperature is 825 F.

B-612

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

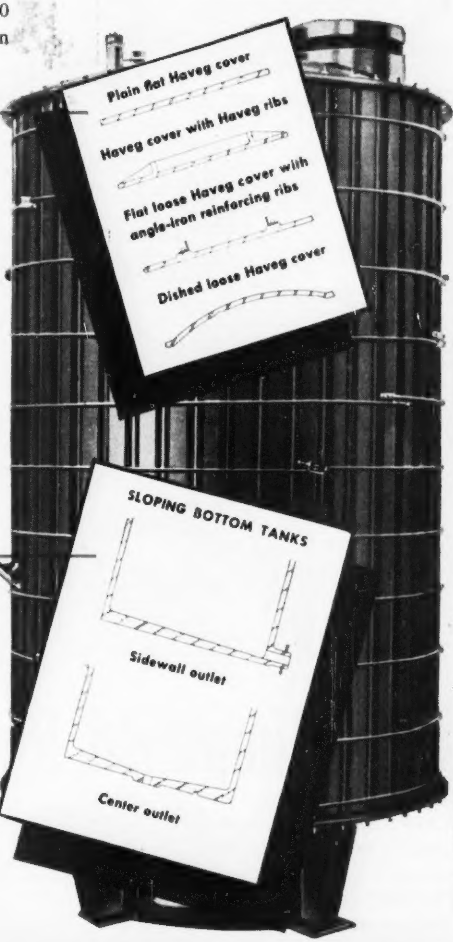
C·E

IMPORTANT ANNOUNCEMENT! FACTORY CAPACITY HAS BEEN DOUBLED! DELIVERIES ARE GETTING MUCH BETTER!

TANKS

HAVEG

HAVEG is not a tank lining or coating. It is a solid, molded non-metallic material that the HAVEG CORPORATION fabricates to your specifications in its Marshallton, Delaware plant. Large size equipment can be molded in single pieces without seams or joints at low cost. Tanks can be made in one seamless piece as large as 10 feet in diameter by 12 feet in depth. HAVEG resists the corrosion effects of practically all acids, bases, and salts.



From TOPS

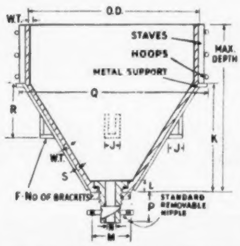
Where tanks are vented to the atmosphere, four types of covers may be obtained. HAVEG can be machined and repaired readily so that pipe connections, manholes, changes to the system present no problem to the installation and maintenance crew.

HAVEG CYLINDRICAL TANKS CUT COSTS . . . RESIST CORROSION

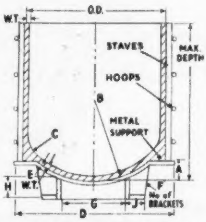
Here are tanks with amazing long life, through and through resistance to corrosion! HAVEG cylindrical tanks have been successfully used for storage, pressure, pickling, and separating tanks, dye vats, crystallizers, surge tanks and stills. Consult your nearest HAVEG engineer now for technical advice, delivery, and price information. Specify HAVEG corrosion resistant equipment . . . tanks, towers, pipes, valves.

To BOTTOMS

Get the best bottom for the process with molded HAVEG. Sloping bottom tanks can be provided with outlets at any location. For more complete drainage, dished bottom tanks are available and when suspended solids are present, cone bottom tanks can be provided.



Cone Bottom Tank for applications requiring complete drainage.

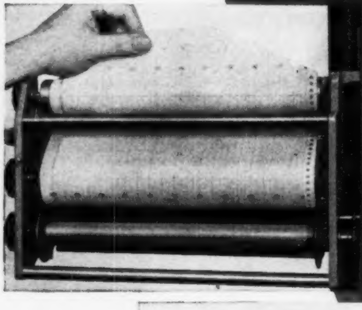


Dished Bottom Haveg Tank

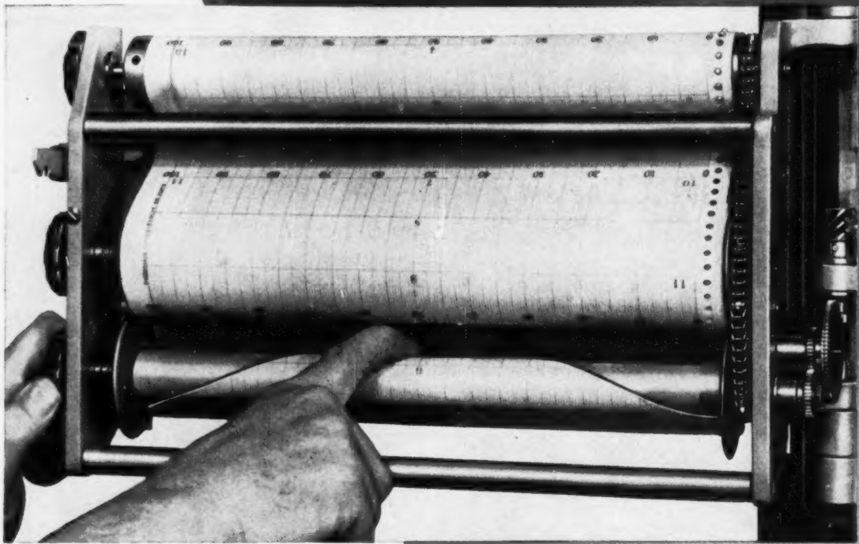
Write Today for a complete 64-page, illustrated, technical bulletin on HAVEG corrosion resistant equipment. This Bulletin F-6 has chemical resistance tables for various HAVEG grades, tank sizes, installation and machining information. If you have a corrosion problem, HAVEG can help you. ***Write Now!***

HAVEG CORPORATION
NEWARK 8, DELAWARE
FACTORY • MARSHALLTON, DELAWARE • TEL. WILMINGTON 3-8884

CLEVELAND 14 550 Leader Bldg. Cherry 1-7297	CHICAGO 11 1201 Palmolive Bldg. Delaware 7-6266	DETROIT 35 19951 James Couzens Hghwy. Broadway 3-0880	CHATTANOOGA 2 825 Chestnut St. Tel. 7-7478
HARTFORD 5 86 Farmington Ave. Hartford 6-4250	HOUSTON 4 4101 San Jacinto Jackson 6840	LOS ANGELES 14 523 W. Sixth St. Mutual 1105	SEATTLE 7 5600 14th Ave. N.W. Hemlock 1351



You install charts this simple way!

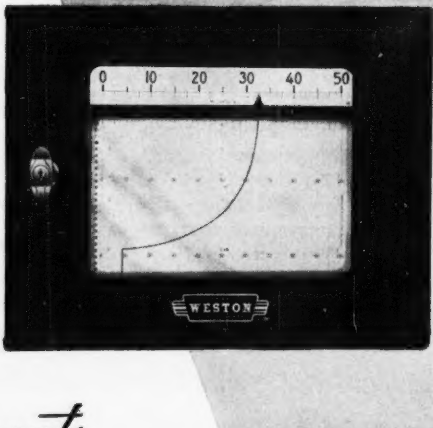


NEW Simplified Recording Potentiometer by WESTON!

Chart changing is a simple 1-2 operation on the Weston Recording Potentiometer. First, note that the chart frame has swung wide open . . . *a full 180°* . . . for complete accessibility. You then insert the chart supply in the frame, draw the chart over the timing drum and down across the front of the frame as illustrated. There are no loose pieces to handle . . . and the whole operation takes but a few seconds!

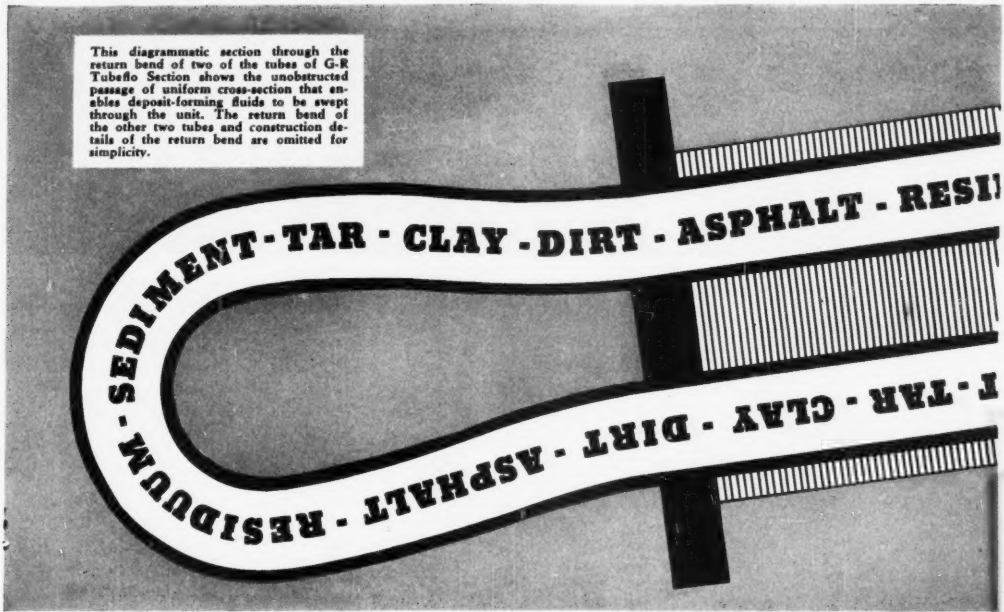
And there are many more features that make this the simplest, most flexible and efficient recorder available. You change chart speeds, for example, by a simple screwdriver adjustment. You change ranges by simply inserting the desired range standard. To service the amplifier, you quickly remove it by taking out two screws and pulling two plugs.

The whole story about this simple and dependable high-speed recorder is available in booklet form. Ask your local Weston representative or write . . . WESTON Electrical Instrument Corp., 617 Frelinghuysen Ave., Newark 5, New Jersey.



WESTON TAG 1628

WESTON *Instruments* . . . INDICATE—RECORD—CONTROL



This diagrammatic section through the return bend of two of the tubes of G-R Tubeflo Section shows the unobstructed passage of uniform cross-section that enables deposit-forming fluids to be swept through the unit. The return bend of the other two tubes and construction details of the return bend are omitted for simplicity.

Can All Be Handled Without Difficulty By the G-R TUBEFLO SECTION

Here is a heater . . . cooler . . . exchanger . . . steam generator . . . that enables you to recover heat from *any* dirty or heavy fluid without fouling. The G-R Tubeflo Section is superior to all other designs of heat transfer apparatus for this type of service because it has a single tube per pass, with no pockets or dead ends; and provides continuous high velocity of fluids through passages of uniform cross-sectional area.

In many installations these units are maintaining initial capacity indefinitely on services which had previously necessitated shut-down and cleaning of shell-and-tube exchangers before the end of a single run.

And this exclusive feature is only one of many advantages of the G-R Tubeflo Section. Your inquiry is invited.

•

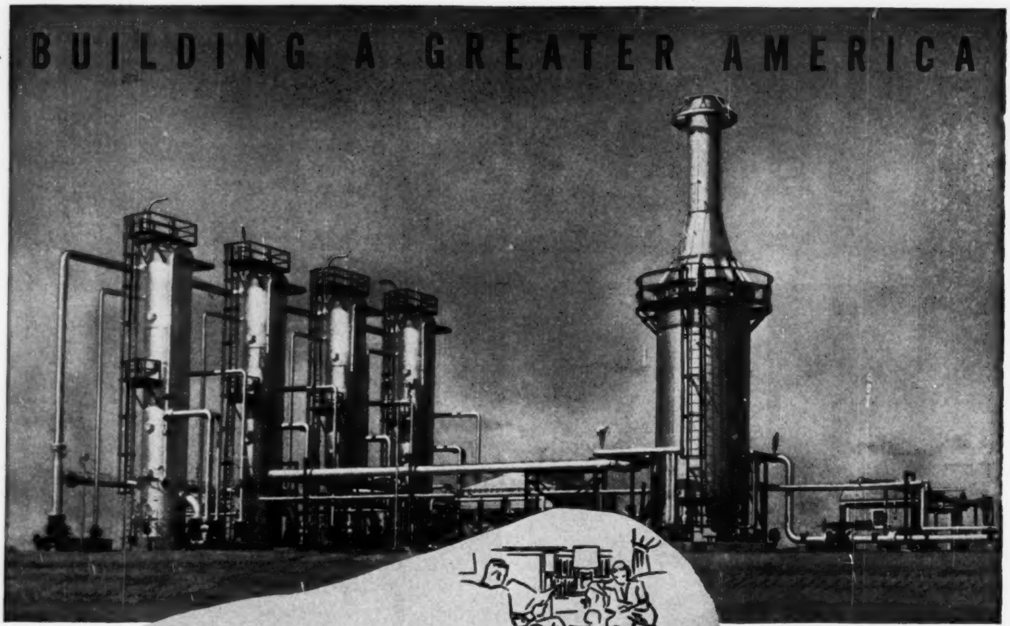
In the G-R Tubeflo Section each fluid flows through two parallel tubes arranged in two passes. The four tubes of the Section are expanded into closely-spaced diamond-shaped fins which bind the four tubes together and transfer the heat from the hot tubes to the cold tubes. All pipe connections are at one end of the unit, and the return end of the unit floats freely on change in in temperature.

THE GRISCOM-RUSSELL CO. • MASSILLON, OHIO

GR 202

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus



Built at Sun Ship, on the Delaware, these dehydrating towers now serve Western homes and industries.

Pioneers in prairie schooners blazed a courageous trail "across the wide Missouri . . ." and across the entire continent . . . in their search for new opportunity.

The industrial services of modern America have followed in that trail. Thriving farms, towns and cities mark sites where pioneers found only hardship . . . because American industry is truly "All-American."

Today, *all* America shares the benefits of *all* of America's progress . . . because great companies develop and distribute the advantages latent in our natural resources . . . and because great industries like Sun Ship can build and deliver, anywhere in the world, the gigantic equipment needed to convert petroleum and various chemicals into light, heat, power and the other productive forces which serve mankind's comfort and progress.

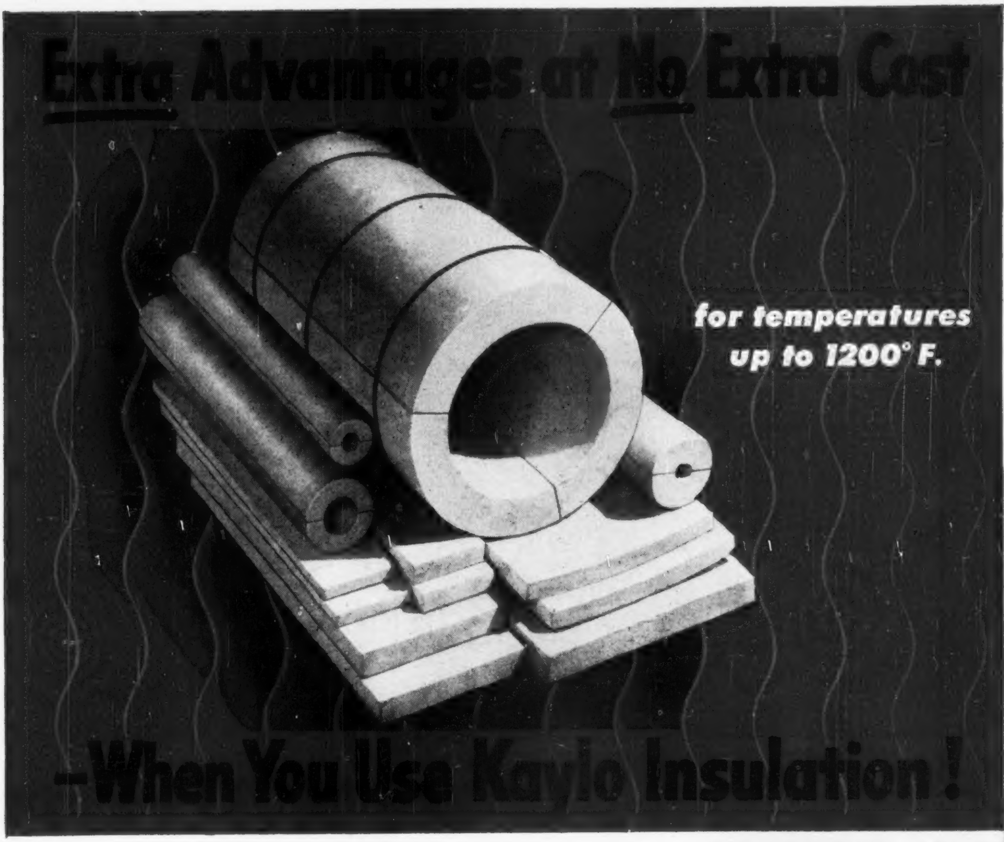
Sun

SHIPBUILDING & DRY DOCK COMPANY

SINCE 1916

ON THE DELAWARE • CHESTER, PA.

25 BROADWAY • NEW YORK CITY



For example, Kaylo Heat Insulation reduces inventory requirements because:

1. Wide effective temperature range—up to 1200° F.—eliminates the need for combination coverings in nearly all operating conditions.

2. Simplified Dimensional Standards allow nesting.

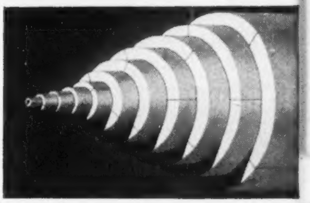
3. Unmatched selection of shapes and sizes reduces the number of pieces required per job.

Kaylo Heat Insulation reduces installation costs because:

4. The material is lightweight, strong and easily handled.

5. It is easy to cut and fit with standard tools.

Kaylo Heat Insulation is a hydrous calcium silicate—the heat-saving material that is revolutionizing insulation practice with its outstanding combination of advantages. Get all of the facts now.



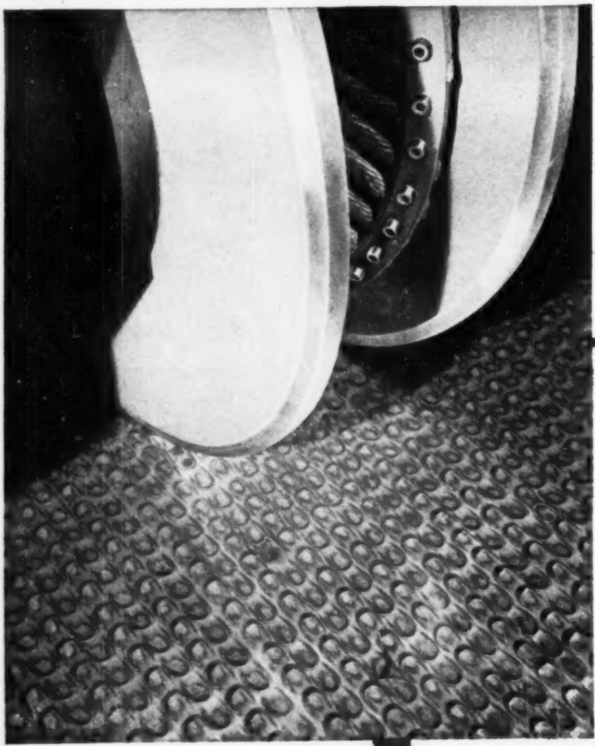
Simplified Dimensional Standards mean that O. D.'s of insulation correspond to O. D.'s of standard pipes, assuring proper fit for nesting, when necessary. With this system of snug nesting, Kaylo Heat Insulation assures fits for all operating conditions, requires less items—reduces inventory stocks.

WRITE FOR FREE BOOK—"Kaylo Heat Insulation." Address: Dept. N-266, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

KAYLO® *. . . first in calcium silicate*

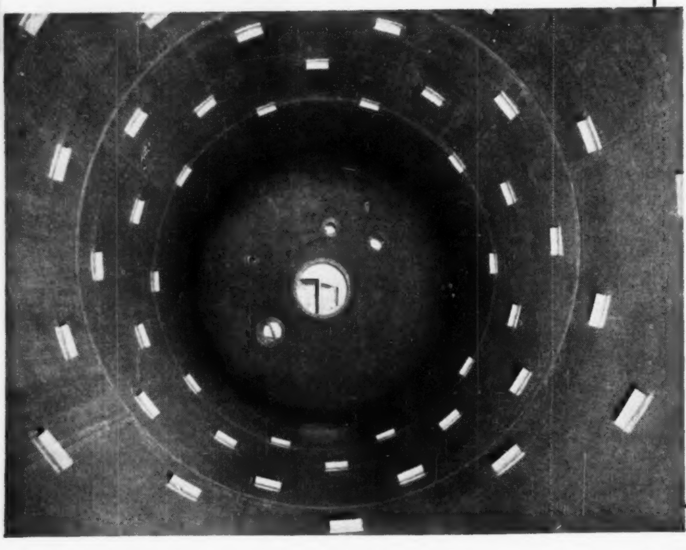
***...pioneered by* OWENS-ILLINOIS Glass Company**

MAIN OFFICE: TOLEDO 1, OHIO—KAYLO SALES OFFICES: ATLANTA • CHICAGO • HOUSTON • NEW YORK • PITTSBURGH • ST. LOUIS



Plus Values

of B&W CROLOY-

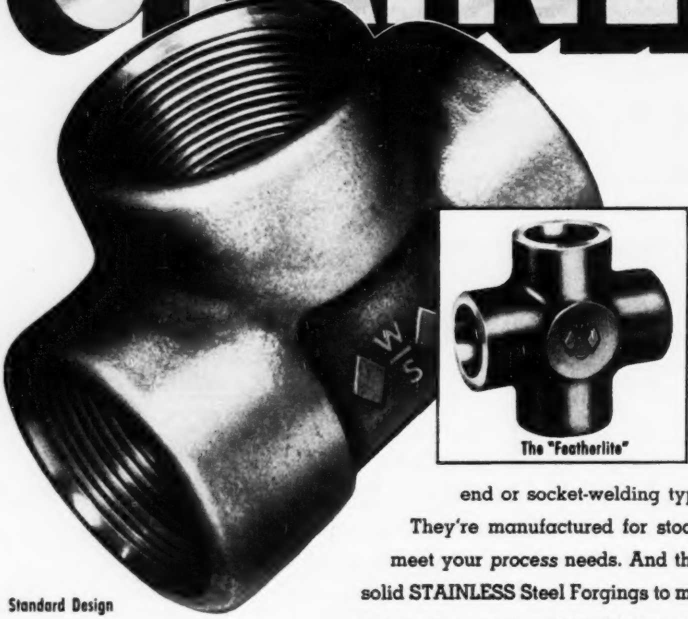


So effective is the bond between base metal and alloy liner in B&W Croloy-Clad pressure vessels that inside welded assemblies are attached directly to the stainless "skin." This faster, more economical and efficient type of assembly leaves the corrosion-resistant lining intact . . . eliminates cut-outs and welding to base metal . . . avoids the accelerated local corrosion that may result from alternative practices.

To meet your needs...

W-S FITTINGS OF FORGED

STAINLESS



STEEL

Stainless systems are critical and costly...Protect them where trouble usually starts . . . with

W-S FORGED STAINLESS FITTINGS

The "Featherlite"

These life-of-the-system joints are available in either screw-end or socket-welding types to meet your *assembly* needs. They're manufactured for stock in the more popular grades to meet your *process* needs. And they're all precision machined from solid STAINLESS Steel Forgings to meet a *universal* need for the strongest, most accurate and trouble-free fittings money can buy.

Get the full benefit of your investment . . . insist on W-S FORGED fittings wherever costly stainless pipe or tubing meet . . . *permanently*.

Standard Design

WRITE FOR BULLETIN S-1 for Standard Design 2,000 to 6,000 pound cold non-shock pressure

WRITE FOR BULLETIN S-2 for "Featherlite" Design 1,000 pound cold non-shock pressure

Screw-End and Socket-Weld Types

• Tighter • Stronger • More Uniform • Lower Service Cost

SOLD THROUGH LEADING DISTRIBUTORS . . . EVERYWHERE

W-S

WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

ROSELLE, NEW JERSEY

9-M-69

Designers and Manufacturers of Forged Steel Fittings, Hand Pumps, Jacks, Wire Rope Shears and Pipe Benders

Memo from the Editor John R. Callaham

EDITOR Cronan (right) talks shop with equipment salesman Peterson*, for . . .

Process Equipment Is His Forte

A little less than a year ago I got an unusual letter from a young engineer up in Massachusetts. His name was Calvin S. Cronan, and he wrote:

"I'm a dyed-in-the-wool equipment man, so naturally I've been a faithful reader of your Process Equipment News department for some years. Next time I'm in New York I'd like to drop around and meet the editor who prepares it. There are a couple of things about it I think can be improved. For instance . . ."

Upshot of it all was that we hired the red-headed Irishman (after due apologies to our friends up at Bird Machine Co., where Calvin was then employed). Then I told him to go ahead and try his own hand at the department. That was last May; he has had it ever since.

▶ **Shoe on the Other Foot**—Several weeks ago Cal and I sat down and talked about the equipment department. I couldn't resist the nasty temptation to ask him if he found it as easy to do as it had been to tell us how to do it.

Cal laughed. "Dammit, John," he came back, "only another ornery Irishman like you could ask me that question and get away with it. The answer is, Hell no!"

And there are several reasons—not always obvious to outsiders—why handling our equipment department gets to be tough going at times. It takes eternal care and judgment—sometimes mixed with a bit of sternness—to stay on the right track. And a practical, working knowledge of the process equipment field, of course. Cal has these.

"Once I've collected all my working material each month," Cal said, "the toughest part is to pick out those new developments that have real value and broad interest to chemical engineers in the process industries."

▶ **30 Percent Pass**—Then Cal pointed out some of the pitfalls in this part of the job. "Every month I get close to 175 items, sometimes more. I study every one (and does that take time!), then start to weed them out. If I'm in doubt—and I often am—I ask other people here in the shop and in industry. Sometimes I'll check with a dozen or more people familiar with the type of equipment and how it's used in chemical processing plants.

"From all these items I'll usually come up with about 50 (the actual count was 46 in October) that pass the acid test. That's about 30 percent of the total."

I wondered if Cal got many complaints about his selection. "I haven't had anyone complain yet that I've used an item that shouldn't have been used. I don't know whether this means much or not."

"In the seven months I've handled the department I've had four real complaints about items I didn't use. I keep a record of these, go back and restudy each one. I was wrong on one of them, so I put it in a later issue. One was clearly a borderline case—a matter of opinion—but to be fair I used it anyway. I was right in not using the other two, and I'm sticking to my guns, too."

▶ **Time to Say No**—Cal never hesitates to make diplomatic use of the streak of sternness in his New England makeup. That is necessary on those rare occasions when a manufacturer tries to "pressure" him into publishing something that doesn't belong in CE.

"I simply tell them the truth and explain our principle that every editorial item must be judged purely on its own merits. Then I point out why it doesn't do them (or anybody) any good to put in items that have little interest or value to our readers or to give the impression that something is new when it really isn't. They understand, and go away with more respect for us and the magazine, too."

Cal's background in industry makes him the logical man to handle our Process Equipment News department as well as many of our feature articles and reports on equipment and unit operations.

▶ **Five Years With Bird**—Before he joined us last May, Cal had spent close to five years with Bird Machine Co. in South Walpole, Mass. There he

(*Continued on page 370*)

* E. A. Peterson, assistant sales manager of the Chemical Process division of Simpson Mix-Muller (a division of National Engineering Co.), Chicago.

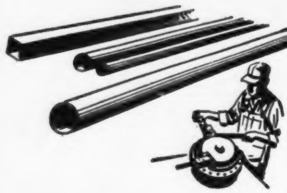
Steel Department Store

For the CHEMICAL INDUSTRY

Here are a few of the many types of steel and related products on hand right now, ready for immediate shipment from your nearby Ryerson plant. Many may be used in place of products that are still hard to get. Check the items you need, and save time by ordering them next time you call Ryerson.

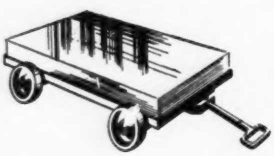
ALLOYS

Tested alloys of known hardenability, both standard and aircraft quality. Complete heat treatment guide with each shipment.



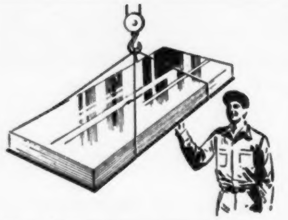
WELDED MECHANICAL TUBING

Hot and cold rolled, rounds and squares in a wide range of sizes. Consider cost. Substitute for seamless tubing.



CARBON SHEETS

Both hot and cold rolled coming into better supply, especially cold rolled in the heavier gauges.



STRAIGHT CHROME STAINLESS

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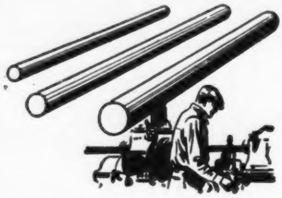

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Water, oil or air hardening steel. High in quality; economical in price. Hardening data with every shipment.

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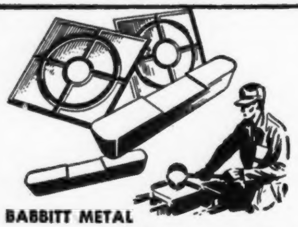
Rugged, dependable TM chain, iron, steel and alloy qualities, furnished to order. High quality wire rope shipped from large stocks.



BABBITT METAL

Glyco Babbitt, an exclusive Ryerson product, has physicals equal to high tin Babbitts; costs substantially less and is unrestricted.

RYERSON STEEL

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • PHILADELPHIA • CINCINNATI • CLEVELAND • DETROIT PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO • SPOKANE • SEATTLE

SIDNEY D. KIRKPATRICK, Editorial Director   JOHN R. CALLAHAM, Editor

Chemical Engineering
WITH CHEMICAL & METALLURGICAL ENGINEERING

DECEMBER 1952

How Protective Coatings Fight Corrosion

To help engineers in their never-ending fight against corrosion, *Chemical Engineering* publishes this special issue on Protective Coatings. It is our 15th Biennial Report on Materials of Construction and thus continues the series we initiated in 1923, almost thirty years ago.

This time we have concentrated our efforts on one of the four most important means of corrosion prevention—the use of inert barriers. Even here we found it advisable to limit ourselves to those materials and techniques that can be applied to routine chemical plant maintenance. This important broad field has long been in need of an interpretive classification and analysis that chemical engineers could put to profitable use.

By limiting our objectives we have been able to give you a better and more useful job. The approach that we have taken, to our knowledge, is a pioneering one in the entire chemical engineering literature. Our studies of the past few years have convinced us that it is both needed and wanted by chemical engineers throughout the process industries.

Most chemical processing plants can save, according to one reliable estimate, up to 50 percent of their maintenance painting costs by adopting a sound painting program. Yet confusion sometimes surrounds the protective coatings and their proper use under corrosive conditions. It is the purpose of this report to help clarify that situation.

The report classifies corrosive atmospheres by the degree of their severity. This can be helpful, since some organic barriers that would fail under conditions of splash and spillage might very well be perfectly suitable —and economical—in less severe environments.

It also groups coatings formulations under the types of basic resins used. This has practical value in helping chemical engineers select the proper coatings for corrosion prevention. Any basic resin type, of course, has its own specific advantages and limitations regardless of the usual variations in compounding.

It points out which form of an organic barrier—coatings, mastics or linings—is most likely to give satisfactory service under various conditions.

It also stresses the importance of proper selection and application, then goes on to point out why the frequent inspection and maintenance of the finished job can pay off in handsome savings.

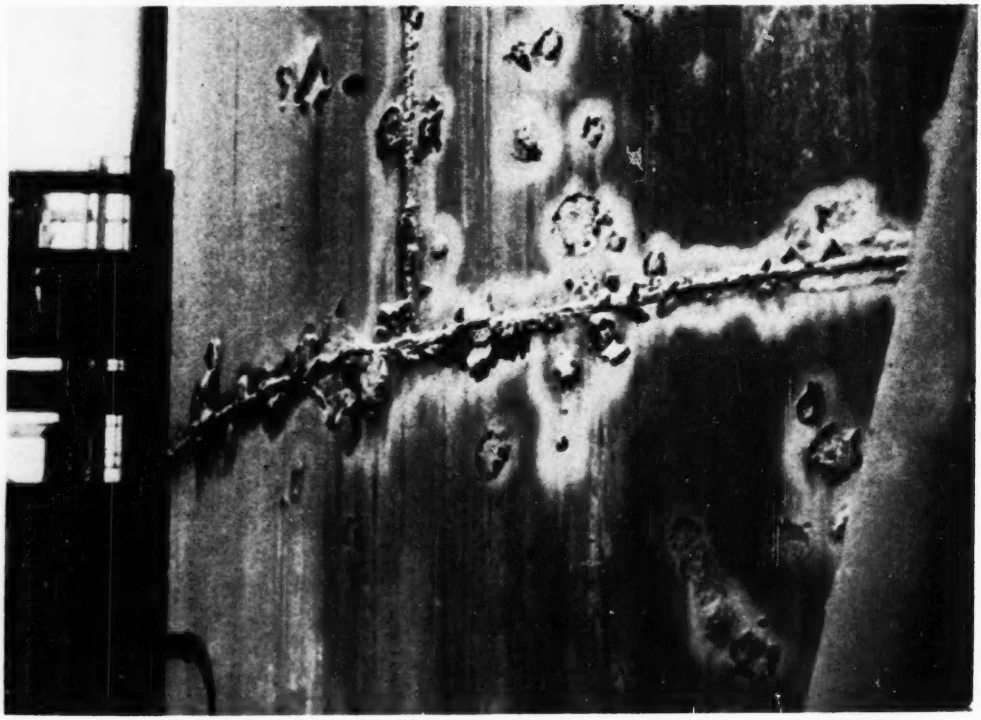
Our report's chart and directory will increase its usefulness to you. The chart gives chemical resistances of the basic resin types to a number of corrosives and exposure conditions. The directory lists trade names and producers of protective coatings. In addition, the other materials of construction commonly used in the chemical process industries are in a second directory. Here we continue and bring up to date the listings that we have published for many years in our biennial reports on Materials of Construction.

Our Protective Coatings report proved to be a major undertaking; yet it is one that we have planned and worked toward for several years. We have been fortunate in getting the help of many people in industry, especially in compiling the directories. Without their cooperation this report, planned and produced under the editorial direction of Associate Editor Morgan M. Hoover, would never have been possible.

We were particularly fortunate in enlisting the cooperation of Mr. Kenneth Tator, an outstanding consultant in the field of corrosion prevention. For many years Mr. Tator has specialized in protective coatings for the chemical industry; most of the contents and data in the report have come from the extensive files that he has built up from years of practical experience in corrosion test work and in chemical processing plants throughout the country.

It is our belief that this, our 15th Biennial Report on Materials of Construction, is the first comprehensive study of its kind ever published. It will prove useful to you in your never-ending fight against corrosion.

John R. Callaham



TO HELP PREVENT CORROSION OF PLANT EQUIPMENT SUCH AS IS UNDER WAY HERE . . .

A Sound Painting Program

Potential savings of 20 to 50 percent of current maintenance painting costs

What do protective coatings mean in terms of dollars and cents?

Each year this nation spends close to $2 billion for painting just to protect its metal structures and equipment against corrosion.† This represents more than a third of the total cost for all corrosion prevention materials and methods combined. Chemical plants naturally take far more than their share of this expenditure.

Every full-time skilled painter employed in your plant costs your company $7,000 a year for direct labor and materials only; overhead is on top of this. Many manufacturing plants have 20 or more such painters on their maintenance payroll. Some of the larger chemical plants spend about $½ million per year for painting.

The importance of a sound painting program is realized when you consider the fact that these costs can be appreciably reduced by such a program. In fact, potential savings of 20-50 percent of current maintenance painting costs are available in most chemical manufacturing and processing plants.

This sizable reduction in painting costs can be brought about by (1) proper selection and (2) proper application of paints.

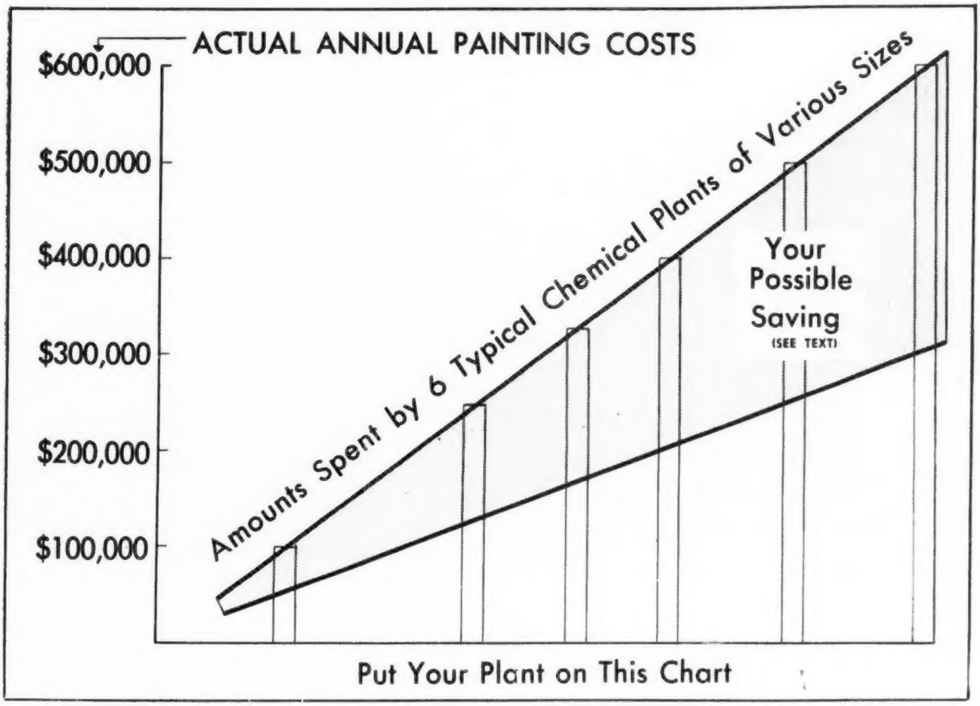
Proper Selection

Involved in proper selection of paints are the choice of the basic resin types and the severity of exposure conditions. Advantages and limitations of these basic types are brought out in this report as is the significance of the various exposure classifications.

Also involved in proper selection is the matter of the most economical method of procurement. Maintenance paints, through long past practice, are purchased after consideration of price and coverage per gallon, which by simple division yields a material cost per square foot per coat for cost comparisons.

This basis for comparison is erroneous in that it disregards thickness of the applied film. For example, it has been shown* that applied costs for

† Uhlig, H. H., *Corrosion*, Jan. 1950, p. 29.



. . . TYPICAL CHEMICAL PLANTS SPEND THIS MUCH IN PAINTING COSTS.

Can Slash Maintenance Costs

are available in most chemical manufacturing and processing plants.

a synthetic system costing $5 per gallon and having an average coverage of 200 sq. ft. per gal. may actually be greater than one costing $7.25 per gal. with a coverage amounting to 150 sq. ft. per gal.

Proper Application

Involved in the second general method of reducing painting costs, which has been designated above as proper application of paints, are a number of important cost considerations.

One is the matter of economic thickness of coatings. Minimum thickness for low probability of early failure is 5 mils.* This minimum thickness can be met with three coats, provided paint systems of sufficient "build" per coat are used. Failure to select a coating system of sufficient build means going to extra coats, each of which adds 17 percent to the cost of the system.

Another important cost consideration has to do with periodic inspection and repair. With a system of periodic inspection and repair, the cost per year, based on a 12-yr. period, is likely to be in the neighborhood of 6.7c. per sq. ft.* This is 54 percent less than when a complete surface preparation and paint renewal operation is performed every three years. (Experience has shown that for many common aggressive chem-industrial exposures, incipient deterioration will occur in 2 yr. and irrepairable destruction in 3 yr.)

For the recommended 3-coat system, the cost of surface preparation is the largest single item of painting cost, approximating 50 percent of the applied cost. This expensive operation of cleaning and etching the base metal need not be repeated every time an area is painted, provided that it is properly done initially and maintenance inspection and touch-up schedules established. These schedules require that each paint application be inspected at definite intervals after application and that local wire-brushing, spot priming and cover coat renewal be done as soon as inspection

* Pierce, R., *Chem. Eng.*, May, 1952, p. 149.

shows the barest beginnings of localized failures.

Results of many studies in chemical industrial atmospheres have conclusively demonstrated that paint life over a sandblasted surface will exceed that over a surface cleaned by conventional hand cleaning methods of chipping and wirebrushing, by two to four fold. There will be considerable variance in this ratio depending upon the severity of the exposure environment and upon the type and formulation of the coating. However, even when using the minimum improvement ratio of a doubled life, and using the painting costs figures of Pierce,* the annual cost of maintenance painting in any plant may be reduced 42 percent by adopting sandblasting as the preferred method of surface preparation wherever dust and safety regulations permit. Interestingly enough in many chemical plant experiences it has been found that the cost of sandblasting is no greater than the labor cost of a careful handcleaning operation. This has been found particularly true when the surface to be cleaned is one of heavy corrosion product saturated with chemical contaminates.

*Pierce, R., *Chem. Eng.*, May 1952, p. 149.

Mis-application of protective paint systems is the most frequent cause of premature paint failure. When we consider that an average of 15c. per sq. ft. is spent to obtain a good surface for painting and on the other hand an average of 17c. per sq. ft. is spent to apply the protective paint coating, it is obvious that the investment on the one side should be protected by insuring that a good and proper job is done in the other operation. No matter how good a job is done in either of these operations the total investment will be completely lost if any part of the operation is improperly conducted. Fortunately mis-application and its results are readily observable and determined.

Most common error in application leading to ineffectual paint protection is that of not observing the requirements of minimum coating thickness. This point has been discussed in the foregoing. Another frequent cause, which will not be further expanded here, is the practice of applying paint over old paint or surfaces which have had no or little surface preparation attention.

Compatibility of newly-applied paint with the old residual paint upon the surface is a consideration often ignored. Cases are common wherein basic paint systems have been changed at every re-painting, without regard for either resistance to the exposure or compatability with the prior application. No matter how well selected or applied, the present paint system will fail prematurely if applied over old paint which is in the process of failure, or is susceptible to the exposure. Instances are known where paint protection consisting of a multi-application is currently in a failing condition, and where the type of failure is uniquely characteristic of the performance of a paint system which is buried three applications deep in the coating film.

Incompatibility within the materials of a single application often result in the loss of material and labor investment through early failure. Instances of the use of turpentine or mineral spirits for thinning vinyl finishes are well known. Such a practice effectively precipitates out the vinyl resin rendering the material useless. A common conclusion arrived at by most students in the field in their preliminary studies is to avail themselves of the superior wetting and penetrating properties inherent in the drying oil primers and to protect these chemical susceptible primers with chemical resistant synthetic topcoats. In theory these conclusions are excellent, but difficulty arises in putting them to practice. The active solvents of the synthetics will soften and lift the primers, adhesion of the synthetic to the prime will be inferior, and premature failures will often result.

Unless prior trials of compatibility and performance have been established, it is not advisable to mix system types. Unless such prior trials of suitability have been made it is always recommended to follow the manufacturers' instructions exactly. By doing so, inter-system compatability is assured and the helpful services of the manufacturers' technical staff will be available in case of trouble or doubt.

KENNETH TATOR

Author of this report on protective coatings is Kenneth Tator of Kenneth Tator Associates, Coraopolis, Pa.

Ken is chairman of the Technical Practice Committees on Protective Coatings for the National Association of Corrosion Engineers, a member of the Technical Coordinating Committee for the Paint Industry, and a registered professional engineer in Pennsylvania.

He holds a number of patents and pending applications for corrosion barriers, plastic products, and container linings—and has authored a number of technical papers.

After getting his M.S. in Chemical Engineering from M.I.T. in 1930, Ken spent 10 years with Dewey and Almy Chemical Co. There he did design and product development work, was in charge of production quality control, and Director of the Closure Research Division for the last five years of his stay.

Then, as a chemical consultant to Dewey and Almy and *Chemical Industries* magazine (now *Chemical Week*), Ken prepared market analyses and forecasts.

After this short period as chemical consultant, Ken went to Washington during 1941-1944 to serve with the War Production Board. There he held posts as chemical consultant with the Bureau of Industrial Conservation; Chief of Commodities Unit and Deputy Chief of Non-Metals and Industry Section of the Conservation Division; Deputy Chief of Inter-Agency Staff, Conservation Division; Special Assistant to the Rubber Director and Chairman of the Requirements Planning Committee, Office of Rubber Director.

In 1944, Ken founded and became president of Industrial Lining Engineers, Pittsburgh, Pa. This firm is engaged in the design and application of corrosion and abrasion resistant linings. It is now the Industrial Lining Div. of Chase Chemical Corp.

In 1949 he founded his own firm of Kenneth Tator Associates, corrosion engineering firm specializing in corrosion and abrasion protective materials.

The 4 Most Important Ways to Control Corrosion:

Your 15th Chemical Engineering Report on Materials of Construction

1. Inert Barriers (applied to supporting structure)
   a. Metallic
   b. Vitreous
   c. Wood
   d. Organic barriers (other than wood): coatings, mastics & linings
2. Corrosion-Resistant Structures (monolithic)
3. Corrosion Inhibitors
4. Cathodic Protection

Organic Materials vs. Corrosion

Classification of exposures by degree of severity, grouping of formulations under basic resin types, and choice of proper form all simplify selection.

The term "protective coatings" is today in diverse, and non-uniform use. It is subject to the individual definition.

Broadly speaking protective coatings include all resistant or inert barriers which are interposed between corrodable metal and corrosive environment. The inclusion of the word "coatings" within the term assumes that the barrier is adherent to and conforming to the surface of the metal. This broad definition of "protective coatings" would include metal clad, sheathing, and electroplate; glass and other vitreous linings and coatings; as well as wood linings and sheathings. Such linings and coatings, however, are relatively expensive in their applied cost and their application requires specialized equipment and skills to such an extent that they are usually applied in shops specializing in such applications. For these reasons their use is confined to special problems of corrosion, usually for the linings of process equipment. They are not amenable to use for general industrial plant protection, applied as a routine operation by the plant maintenance personnel.

In most popular usage "protective coatings" refer to barriers of organic materials, wood excluded. Within even this usage, they may refer to paints and coatings, mastics, and linings—or may refer only to such applications of the thinner films in thicknesses 10 mils or less commonly used as a maintenance paint.

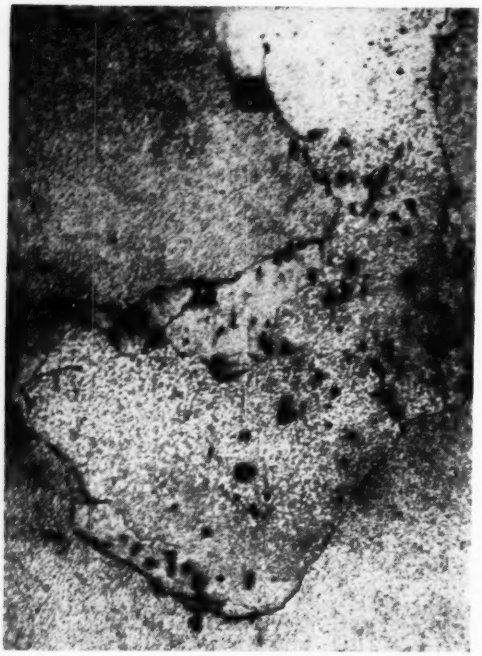
This presentation will confine itself to consideration of the organic materials, as these are most practically employed for general plant maintenance and can be readily applied by plant maintenance crews. The broader definition will be employed within which the thin paint-like films, organic mastics, and the heavy sheet linings all receive full attention. In the following, however, the use of the word "coatings" refers to applications to a finished thickness of 10 mils or less, linings to thicknesses above 1/16 in. and mastics to liquid-applied barriers of thickness intermediate between these.

Use of organic materials for corrosion protection is one of the oldest forms of corrosion prevention. Wood, rubber, and tar or pitch linings antedate all other forms of corrosion prevention with the exception of a few corrosion resistant metals.

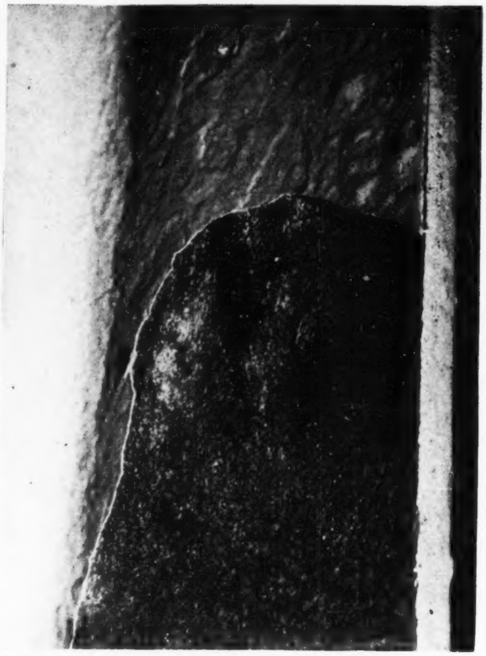
Organic materials owe their utility to their selective inertness to the corrosive environment, and to their electrically inert properties which prevent completion of galvanic circuits which would promote corrosion. With the notable exception of wood, the organic materials do not possess structural strength and such strength required for their industrial use must be supplied by other materials, most commonly backings or frameworks of corrodable steel. Thus in practical use, organic materials are most commonly encountered as linings or coatings where they serve as physical, inert barriers between the corrosive environment and the corrodable base metal.

Use of inert barriers is normally proper and suited for the protection of all corrodable metal, structures and

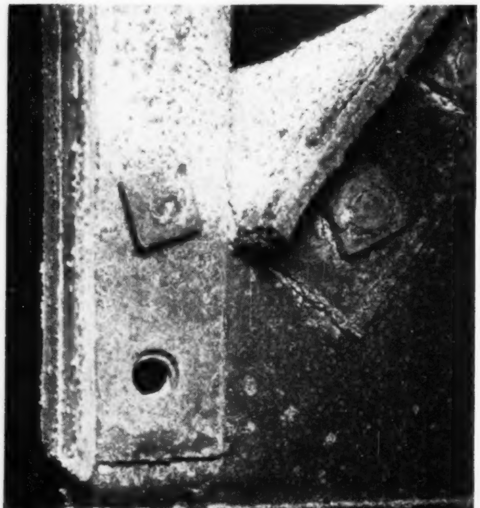
Appearance and cause of typical coating failures



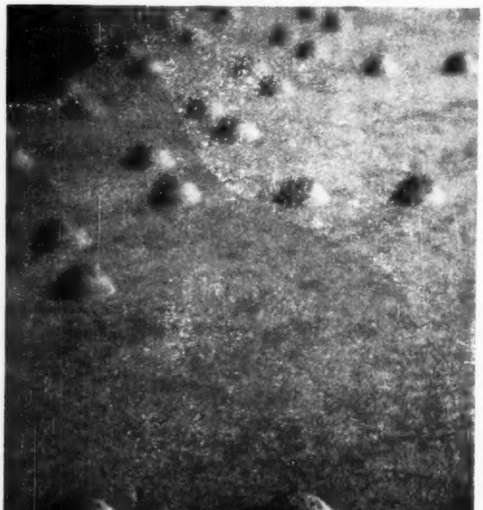
Paint failure caused by paint application to a moist surface.



Laminar failure by poor adhesion of coats in a single system.



Failure at crevices, sharp corners will destroy entire film.



Early paint failure at prominences and crevices of rivets.

equipment where regular inspection and maintenance is practical, where metallic contamination of products is deleterious, and where stray or imposed electrical currents are the cause of, or accelerate corrosion. They are not suitable for high temperature applications or for prolonged contact with strong oxidizing agents.

Organic barriers may be used by themselves or used in combination with other methods of corrosion control. Ofttimes combination control is the most economical. As examples we have the protection of oil and gas underground pipelines where protective coatings are used to reduce the current consumption required for cathodic protection. A similar reduction in the area of corrodable metal will substantially reduce to a minimal concentration the use of corrosion inhibitors required for many processes.

In the proper and economical use of organic materials, consideration should always be given to the alternative use of the three other means of corrosion control—namely corrosion resistant metals, cathodic protection, and corrosion inhibitors—to determine that these will not provide a more economical solution of the problem at hand. Each of these four means of corrosion control has its particular advantages, and each has its limitations. In their proper use they are seldom competitive one with another, and should not be so considered. The use of inert barriers, where the economic solution lies in other means, is a mis-application of such barriers and should not be encouraged.

Classification According to Service

In evaluating coatings for their suitability for chemical plant protection there are two factors which must be considered, both obvious but frequently ignored in practice. The first of these is recognition of the type, source, and plant-affected areas of each chemical corrosive emitted by the processes within the plant. It is obvious that a coating system which has proved entirely suitable for resisting the acidic atmospheres within one process area may be entirely unsuited for a caustic atmosphere which prevails about another adjacent process.

Furthermore it is very easy, but uneconomic, to specify the general use of a coating system—which trial in areas of high fume concentration, splash, and spillage has proved its merit—to all plant atmospheres affected by those same corrosion fumes. In general a coating system which will withstand satisfactorily high concentrations of fumes, splash, and spillage will be a premium-priced, heavy-duty coating material applied according to expensive application requirements. In the milder yard areas affected by these same fumes it is obvious that such heavy and expensive protection is not required. The author's laboratory conducts all coating surveys and recommendations with the consideration of the following four service conditions (these classifications are for chem-industrial exposures: to include normal industrial, urban, semi-rural, and rural exposures; additional classifications should be added):

Class I Exposure—Service conditions under which the coating is subjected to continual and direct contact with the corrosive. This condition is exemplified by organic linings for interiors of process equipment, and includes immersion or partial immersion conditions. Within limits, cost for effective protection is usually not a factor and the best suitable material and relatively expensive surface preparation and design, as well as many multi-coat applications, including baking or special treatments may be tolerated.

Class II Exposure—Service conditions in areas of high concentration of corrosive fumes and under frequent splash and spillage. An example of such service is the coating of the exteriors of process equipment. It is possible to obtain such protection with a three-coat system, high film thicknesses preferred. Materials should be heavy duty materials of excellent resistance, but surface preparation, design, and application need not be up to the severe standards of Class I service.

Class III Exposure—Service conditions in which the coating protects steel against relatively high concentrations of fumes, but with little or no splash or spillage, or direct contact with the solid or liquid corrosive. This use is exemplified by the protection of structural steel within the building containing the chemical process. Chemical maintenance paints of good durability are selected for use and application need not be as meticulous as for the prior classes.

Class IV Exposure—This service is against mild concentrations of corrosive fumes, and coatings used in such services usually should have good resistance to weathering. This service condition is exemplified by yard areas, outside and adjacent to process buildings. Coatings for such services can be of the less expensive materials, although selected for effective use, and the usual methods of scraping and wire brushing are entirely suitable for surface preparation prior to the coating.

Basic Types

Although there are innumerable trade-named paints and coatings, mastics, and linings offered industry today, it is significant that there are only some fourteen types of organic materials in extensive, successful use for industrial maintenance. Obviously the multitude of proprietary materials must represent duplications and modifications in the formulation of these few basic types. It is possible then to subdivide these into groups according to basic type, Within each group all formulations will have similarities in properties, performances, and limitations determined by the physical and chemical properties of the base.

These common basic types include:

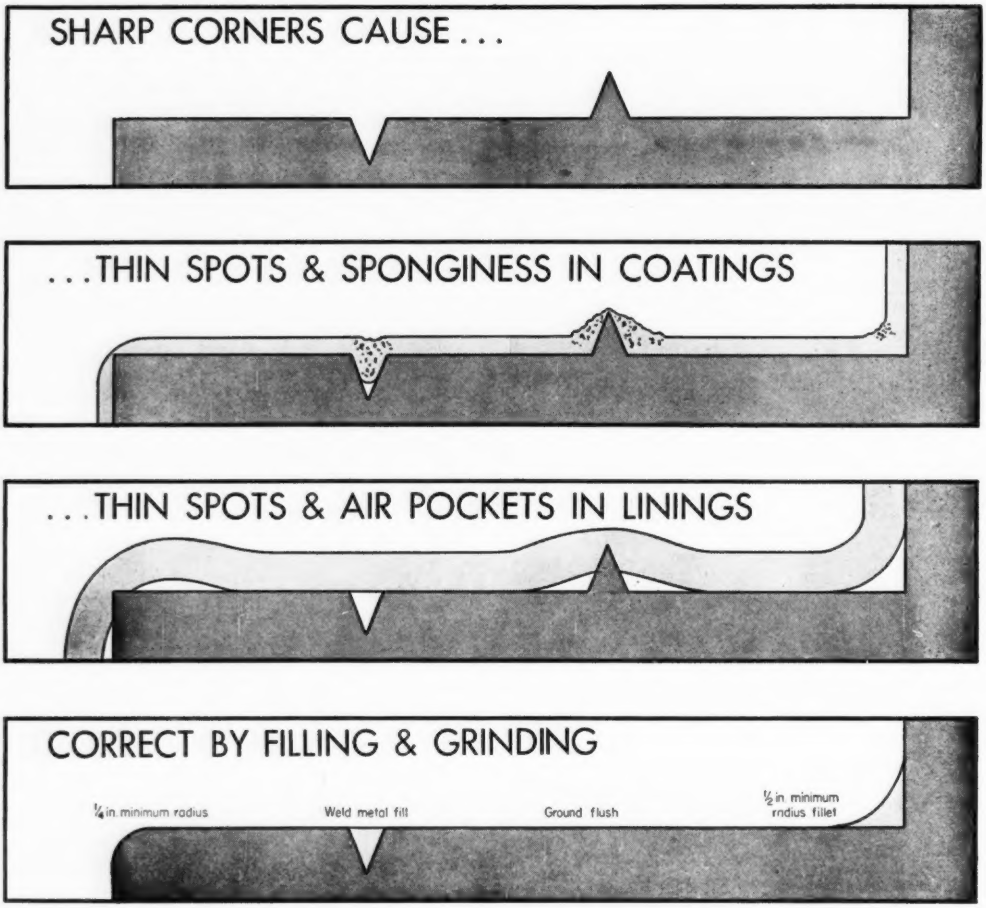
Elastomers—natural rubber, butadiene-styrene rubber, and neoprene.

Thermosetting—phenolics, furanes, epoxy resins, and oleoresinous oils (special case).

Thermoplastic—vinyls, vinylidene chloride copolymers, polyethylene, saturated oils and waxes, chlorinated rubber, styrene-butadiene, and bitumens.

It is true that variations in compounding and processing may act to offset certain of the basic limitations or fortify desirable properties of the basic material, but it is safe to assume that all formulations using a common basic film-forming material will possess in general similar basic physical and chemical properties and limitations.

In any consideration of use of organic barriers, selection of the required properties should be made from available physical and chemical data to determine the more promising basic film forming types. Then various proprietary formulations based upon



those materials which are best suited for the particular end use should be tried. Such a procedure will not only put intelligent direction into any organic coating or lining consideration, but will also eliminate an endless and hopeless job of trying all proprietary materials at random, or as they are called to attention.

Within this recommended procedure it is necessary that manufacturers divulge the type of basic film-forming material used in each of their formulations, and all potential users should insist upon this information before consideration of any manufacturer's product. No reputable manufacturer will refuse this information, and such refusal reflects immediately upon the technical integrity of the manufacturer.

A discussion of common properties and limitations of the three subdisions of the basic types will further classify the available formulations and allow preliminary selection among them.

Elastomers—Elastomers include the rubbers and all rubber-like materials. Like rubber, they possesss distensability, resilience, and therefore excellent abrasion and impact resistance. In its narrowest sense the term "elastomers" includes only those materials in most common corrosion use including natural rubber, synthetic butadiene-styrene rubber (GR-S), and neoprene. There are many other types of synthetic rubbers in industrial use but these have not yet attained stature in the field of industrial corrosion protection.

In the sense that these elastomers require polymerization after application to develop their optimum properties they possess similarity with the thermosetting resins. The latter, however, do not normally possess the distensability and resilience of the elastomers.

Many thermoplastic materials (including the vinyls, vinylidene chloride copolymers, and polyethylene) can be extruded, molded or deposited from hot-melts or dispersions in thick forms which possess comparable distensability and resilience to the true elastomers. In such forms they are suitable from this standpoint for the same uses as the elastomers. Inasmuch as they do not require subsequent polymerization after application to develop their optimum properties, they do not fall within the strict classification of "elastomers."

Elastomers find their predominate

use as heavy duty sheet linings for the interior of process equipment in severe corrosive service. Owing to their protective resiliency they are also in wide use for abrasion-resisting purposes. In these two uses they are normally applied as sheet linings in lining thicknesses between $\frac{1}{16}$ and $\frac{1}{4}$ in. in thickness. They are also available in solution and dispersion form, in which forms they make very useful mastic compositions and, diluted, effective coating compositions.

Thermosetting Resins—Thermosetting resins are exemplified by the phenolics, furanes, and epoxy resins. They are characterized by the necessity of further polymerization after application to develop their optimum physical and chemical characteristics. With respect to this requirement they are very similar to the elastomers. However, the thermosetting resins do not possess the distensability and resiliency characteritics of the elastomers. After polymerization they present rigid, smooth, and tough films and coatings which are unusually resistant to elevated temperatures and general solvent action.

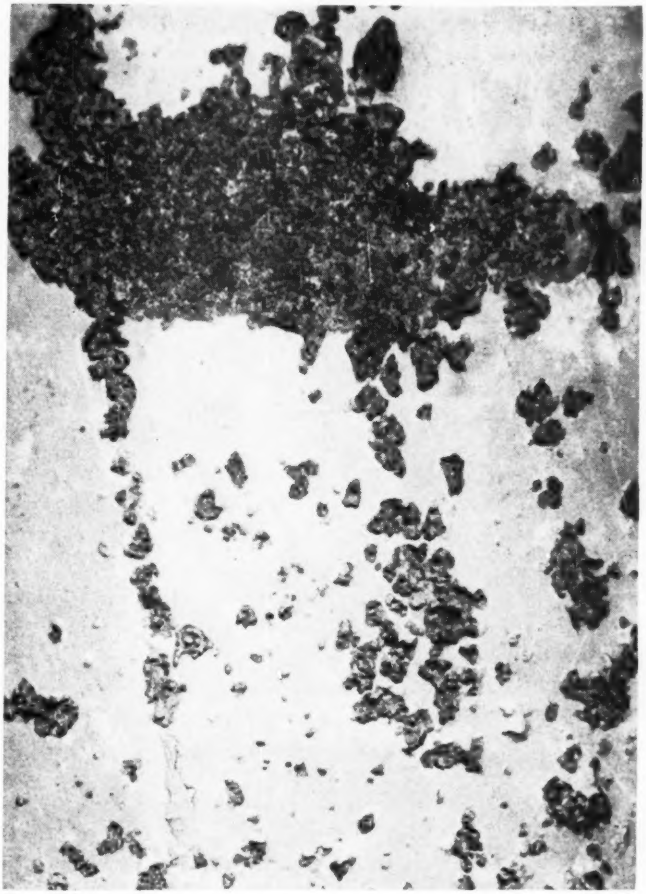
They are obtainable as thin airdrying coatings (which require polymerization after application, however), as substantially non-volatile casting liquids which may be used in mastic or coating applications, in the form of cast sheet, and in cast or molded articles and fittings.

Thermoplastic Resins — Thermoplastic materials are those which do not require further processing or polymerization after application. The applied films and sheetings are softened by elevated temperatures and the materials are always susceptible to their specific solvents.

They are applied from solutions or dispersions as paint and coating bases, and in high solid solutions or dispersions as mastic compositions. All are available as sheeting. Special forms, shapes and fittings can readily be produced by injection molding processes or extrusion. Many of them will resist degradation to sustained heat to allow their application in a molten condition or by means of the conventional flame or hot air guns.

Oleoresinous Oils — Oleoresinous oils, or more commonly the drying oils, are the principal raw materials of the paint industry. They are unsaturated oils, which on exposure to air combine with oxygen to convert to a saturated film-forming solid. This oxidation process after application improves their physical and chemical resistances and makes them a special case of thermosetting materials. Being glycerides in various stages of saturation, they are basically not chemically resistant. They are particularly susceptible to attack by alkaline exposures. Improvement of water resistance and acid fume resistance can be obtained with more resistant oils; also by fortifying such oils with resins.

They are principally used as decorative paints and the protection of steel from corrosion in Class IV exposures.



Paint failure too far advanced for economic repair. Requires complete surface prep.

Physical Forms Available

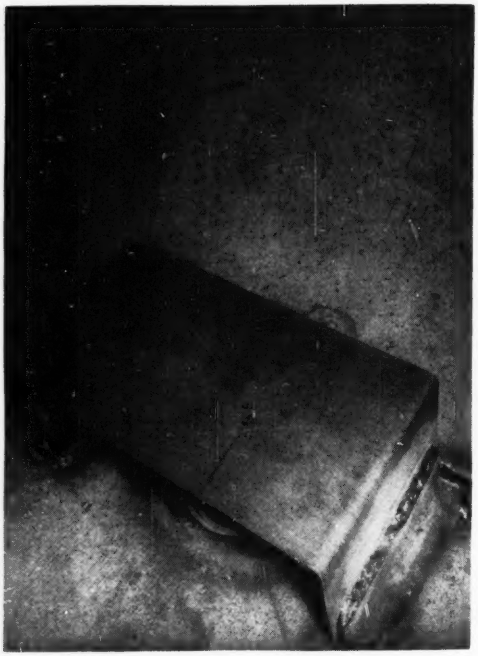
Most of the basic film-forming materials are available in a considerable choice of forms. This means that after the more promising basic types of materials have been pre-determined, these materials can be selected in the form most suitable for the intended service.

They are all available in solvent solutions or dispersions. Many are available in aqueous emulsions, which lend themselves to ready application by conventional brushing, spray, or dipping procedures. From such media they may be used like, and serve as, conventional paints.

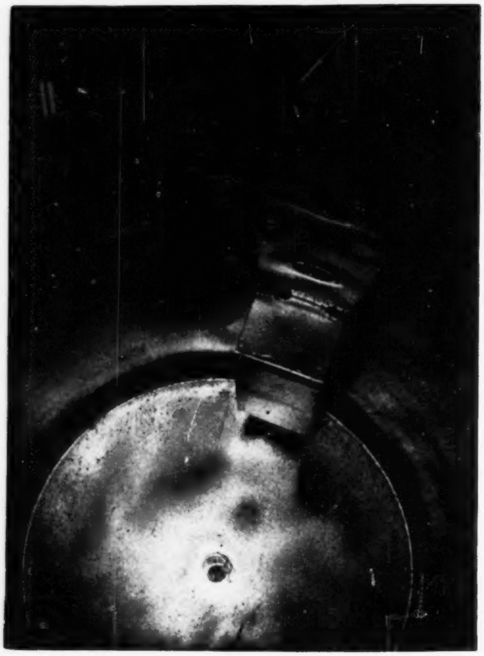
By increasing the solids content of such solutions, dispersions, or emulsions they are obtainable in mastic, paste, or putty form which lend themselves to the usual mastic applications by trowelling or application by compound pressure material pumps. Most

These designs usually mean premature metal exposure

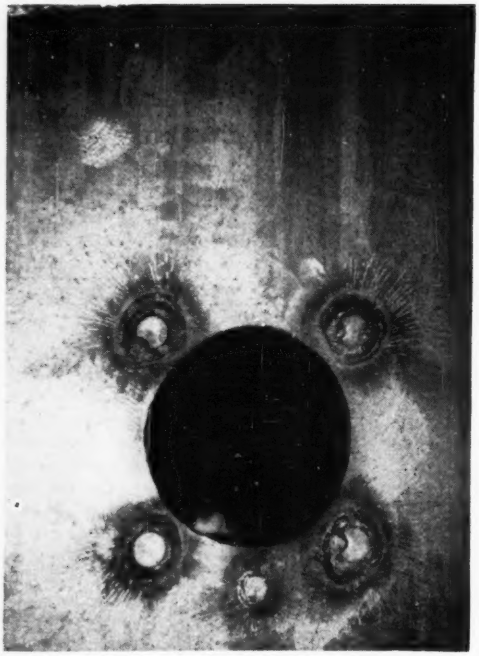
Sharp edges and crevices.



Poor baffle design.



Poor baffle design.



Prominences, rough welds, sharp and jagged edges.

of these basic materials are also available as calendered or extruded sheet stock, which may be then used as interior linings for process equipment by cementing, fusing, or vulcanizing them onto the steel surface.

Again most of them are obtainable in special molded or extruded articles and shapes, by which process sheets of special design such as pipe fittings may be readily produced.

Many of the thermoplastic materials may be melted and applied to surfaces in a molten condition by direct melting and applying, dusting onto a surface heated above their melting point, or by the action of the various flame guns available on the market.

Choice of Form

Choice between the various available forms is self-evident in the case of fittings and other special designs. In such cases the use of moldings or extrusions is apparent.

Confusion exists at times, however, between the choice of using a material for protection of metallic surfaces in the form of paint-like coatings, heavy mastic applications, or as sheet linings. The following will discuss the considerations to be used in determining such a selection.

For all practical purposes the determination of whether a material should be used as a paint film, a mastic coating, or a sheet lining resolves itself fundamentally into the question of the required thickness for the corrosion barrier. Paint films usually yield thicknesses up to 0.01 in. (10 mils), mastics between 0.01 in. and $\frac{1}{16}$ in., and sheet linings for thicknesses over $\frac{1}{16}$ in. If we assume that the physical and chemical properties of any given base formulation are substantially similar regardless of which one of these three forms is applied, the decision resolves itself entirely to that of the thickness required.

Theoretically a material which has been proved inert to the corrosion environment will be able to protect the base metal against the corrosion effects of that environment at any thickness, providing the thickness is sufficient to achieve unbroken continuity of the barrier film.

However, at low thicknesses the probability of having inadvertant pinholes or omissions in the film during application is great—particularly over the sharp edges, projections, welds, and crevices normally encountered in industrial structures and equipment.

Furthermore such thin films are not liable to maintain an unbroken surface when subjected to scraping, abrasion, and impact injury common to many industrial operations. Where such discontinuities in the barrier film occur, regardless of source, base metal will be exposed for corrosion. The heavier linings and coatings in thicknesses in excess of $\frac{1}{16}$ in. with proper application will yield films which expose no base metal, and the thickness will more effectively resist mechanical abrasions and injury common to industrial use.

Seriousness of corrosion is measured by the rate at which such corrosion destroys, or renders inoperative, the metal of the equipment and structures exposed to such corrosion. Obviously, in most instances, activity of corrosion which will completely destroy a $\frac{1}{4}$ in. steel plate in 20 years is not considered serious corrosion, inasmuch as the time required for such destruction of equipment is greater than its usual obsolescent life.

Rate of corrosion of steel is usually measured as inches of penetration per year (ipy.). Where corrosion by pitting is the predominant factor, progression of the corrosion pits may be measured in the same units. For the example cited above, wherein a $\frac{1}{4}$ in. steel plate is destroyed in a 20 yr. period the ipy. will equal 0.0125. Corrosive intensity of any environment may be measured directly in these units by well-established procedures, or may be estimated with reliability from past experiences with metal life in the environment in question.

An arbitrary division according to corrosion rate is established at 0.05 ipy. to divide highly corrosive environment from environment which are considered of less serious corrosive activity. This level is of an order to destroy a $\frac{1}{4}$ in. steel plate in 5 years.

With corrosion rates higher than this value, it is considered that complete protection or separation of the base metal from the environment is required for effective protective life. Below this value bare exposed metal will still give, in most cases, a useful performance. Special service conditions, or policies within any company, may require that this dividing level of activity be set at some higher or lower figure. For the purposes of this presentation, however, the division point of 0.05 ipy. will be used.

Where the corrosion rate of the base metal to be protected exceeds 0.05 ipy. against the intended corrosive environment, no trust should be placed in organic barriers of thickness less than $\frac{1}{16}$ in. and minimum thicknesses of $\frac{1}{8}$ in. are preferred.

As normal paint applications rarely exceed 0.002 in. per coat (2 mils), it would be economically impractical to build up such minimum thicknesses by means of paint formulation. Therefore sheet application, and in some instances mastics, are indicated. Thick linings may often undergo surface oxidation, chalking, or softening while maintaining an economic protective life. In the use of thin paint films such surface deterioration will rapidly destroy the barrier.

Thin films of the paint type, however, do have their place. In fact the greatest use of organic materials as corrosion barriers is in this type of service.

For the protection of plant equipment and structures where the surfaces are available for regular inspection and renewal of the paint film, and where the corrosion rate of the base steel in its service environment is less than 0.05 ipy., paints provide the most economic protection. Such protection ranges in cost from 60c. per sq. ft. of surface protected per year down to as low as 5c. per sq. ft. per year. Under such conditions it is doubtful where any other means of corrosion protection can meet this cost.

Furthermore thin coating films are useful in preventing metal contamination or discoloration of the corrosive product. In these instances they are normally used as equipment linings, and are restricted to uses in which the corrosion rate of the base metal under service conditions does not exceed 0.05 ipy. For such protection from undesirable contamination at ipy.'s in excess of 0.05 the sheet linings or mastics may be satisfactorily used. This use is one in which no other means of corrosion protection serves quite as well as the organic barriers.

Corrosion-resistant metals do have a real solution rate even though low, and with their use a certain amount of

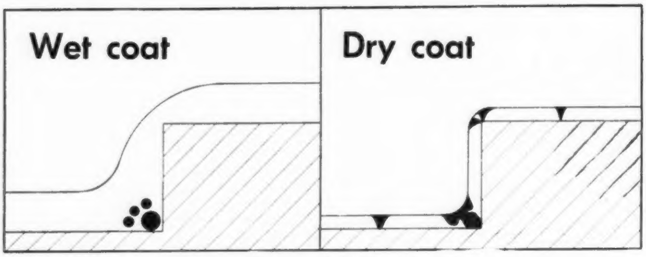
metal contamination will occur. With cathodic protection and inhibitors, it is difficult to exactly offset the corrosion to preclude any possibility of metal contamination. Properly-applied organic barriers, however, always present a non-metallic surface to the product: hence metallic contamination is impossible. In many cases, even the use of thin coatings in which minute areas of base metal are originally or ultimately exposed are permissible in this connection. The extent of metal contamination will be in inverse proportion to the amount of metallic surface effectively covered by the organic coating.

Mastic applications bridge the gap between barriers of paint film thicknesses and those of the heavy sheet linings. This is a thickness field that in the past has received little attention due to relative inability to obtain materials which would apply satisfactory in this intermediate thickness range. This material supply situation is rapidly changing and every day there are more and more materials which are available for application of this nature. Service conditions which justify applications in this thickness range include aggressive corrosion fume conditions where paint films have proved undependable and which do not justify the cost of sheet linings.

The choice between coating films, mastics, and sheet linings depend also upon the relative applied costs of each. Applied costs of the conventional air-drying paint and coating films will range from 20 to 80 c. per sq. ft. applied, mastic coatings from 50c. to $1.50 per sq. ft. applied, and sheet linings from $1.75 to $4.00 per sq. ft. applied. With these differences in applied costs, it is desirable to use that type of barrier having the least thickness range which will give useful and dependable protection.

Protective Coatings

Protective coatings will herein be defined as organic barriers which do not normally exceed 10 mils in applied barrier thickness. For the purposes of this discussion they will not include paints which are used principally in order to impart color or decorate the surface to which it is applied. These materials are available in solution or emulsion and are normally applied by brush or spray, although in certain instances dipping or flushing may be used. They dry to a solid barrier in whole or part by evaporation. Oxidation or polymerization may accompany evaporation.



HOW pinholes form. (Drawn to an exaggerated scale.)

Owing to the relative thinness of their deposit they are not recommended, for reasons previously stated, for protection of base metal where the corrosion rate under service condition exceeds 0.05 ipy. They are in wide successful use for the protection of exterior of plant equipment and structures against atmospheric and chemical fume corrosion, in which use no other forms of corrosion prevention can economically compete. They are also properly used for the lining of process equipment, where contamination of product is undesirable and where the base corrosion rate does not exceed 0.05 ipy.

Pierce* and others have established that no reliable protection may be obtained for general plant maintenance, regardless of suitability of material, with total coating thicknesses over corrodable metal of less than 5 mils. This does not imply that continuous barriers cannot be obtained below this thickness level. In fact it has been established that film continuity seldom requires thicknesses over one mil. It is well known, however, that the liquid applications will draw thin over sharp edges and prominences, and the establishment of this 5-mil minimum, as measured on plane areas, is to insure that there will be sufficient protective thicknesses over the sharp edges and projections, welds or weld spatter, fastenings, and other surface irregularities.

If the equipment or structures are so designed that no such irregularities occur, or that such irregularities are removed by grinding and fillet-welding, effective protection may be obtained substantially below this 5-mil thickness. Such design precautions are impractical in the erection of plant equipment and structures, and are feasible from an economic standpoint only for the lining of the interior of certain troublesome process equipment.

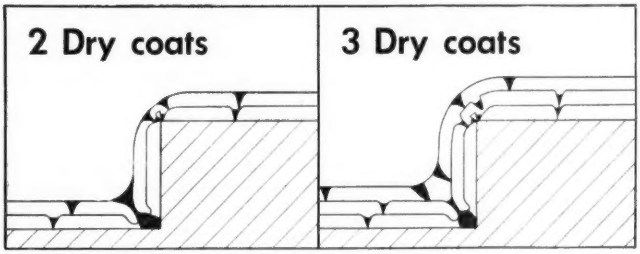
It has long been established that paint films applied in a single coat will have a rather high proportion of pinholes and high porosity. Overcoating with a second coat will substantially improve these conditions but the incidence of pinholes and pores will still remain high. Further addition of a third coat will reduce this incidence of pinholes and porosity to a low value which is not substantially improved by adding more coats.

Therefore, for maximum protective life, coating films should not only exceed 5 mils in thickness but they should also be applied in a minimum of three coats.*

It is significant that each additional coat applied over the required three coats increases the cost of painting by an average of 17 percent.* Such an increase in painting costs makes it desirable to restrict the number of coats applied in general maintenance painting to the minimum which will give the desired protection.

While the condition of the surface to which an organic barrier is applied is important with all forms of application including sheet linings, mastics, and protective coatings, this condition is particularly important in the application of protective coatings. While it is not advisable to deliberately condone such conditions, sheet linings and mastics do have some latitude in maintaining protection while bridging over inadequacies in surface preparation or equipment surface design. The relatively thin films and the high surface

* Pierce, R., *Chem. Eng.*, May 1952, p. 149.



WHY three coats are needed for complete protection.

tension of the paint materials make them very susceptible to early failure over such surface inadequacies.

Sandblasting of the surface is always preferred and recommended in order to obtain the clean surface with sufficient roughness to insure proper adhesion of the coating film. There are many cases industrially, however, where sandblasting is precluded for good reasons of safety, cleanliness, and economics. In such instances the best surface preparation consistent with safety, cleanliness and economics should be used. Improved adhesion and performance with surfaces of inferior cleanliness may be improved by the judicious selection of metal priming coats that possess good wetability, penetrability, and corrosion-inhibitive properties.

From the standpoint of application, protective coatings used for chemical plant maintenance may be divided into two distinct classes. The first of these is the old time-honored oil base coatings which dry predominately by oxidation. The second class of increasing importance is the synthetic paints which dry entirely by evaporation.

The oil base coatings possess wetability and penetrability to a high degree and are thus superior to synthetics for adhesion and performance over imperfectly-prepared base metal surfaces. They are not notable for their general resistance to chemical fumes and environments.

Synthetics conversely require more careful surface preparation or primes designed to help in this respect, but possess greater universality of chemical resistance than the oil base coatings—which accounts for their widely increasing use for maintenance protection in chemical manufacturing plants.

This distinction between oil base and synthetic coatings becomes real and important during the application of such coatings. The present generation of industrial painters has been carefully skilled and instructed through long years of practice in the technique of applying oil-base paints. The fast-drying synthetics cause such painters trouble and discomfort in application, unless they have been specifically trained in their use. The synthetics can be applied as easily as the oil-base paint but an entirely different application technique is employed.

An often-abused consideration in the application of protective coatings has to do with drying times between coats and before putting into service. Coatings which dry in part by oxidation or polymerization often require a definite exposure to favorable drying conditions before they are ready for overcoating.

With many oil base coatings this minimum drying time is of the order of two to three days. Recommended drying times should not be shortened in the desire to get the equipment back into service as the performance life of the coating will thereby be impaired. Balancing this requirement, however, is a maximum drying-time limitation, which is particularly pertinent in chemical plant maintenance use.

Undercoats, and particularly prime coats, are designed to give other advantages than chemical resistance. Chemical resistance of the completed paint system is supplied by the cover coats.

In most cases of plant maintenance painting, the prime and other undercoats will be exposed during the drying period to chemical fumes, to which they are not particularly resistant. A prolonged drying period may be of sufficient length to allow severe attacks, alteration, or destruction of these applied undercoats.

Therefore, it is desirable to select coatings which have the shortest possible minimum drying period for re-coating. In general this rapid dry characteristic is best possessed by the synthetics, and under chemical fume conditions synthetic undercoats usually give best performance.

Mastics

Mastics may be defined as any liquid or paste composition which by economic application procedures and number of coats will readily yield total barrier thicknesses between 10 mils and $\frac{1}{16}$ in. over corrodable metal base.

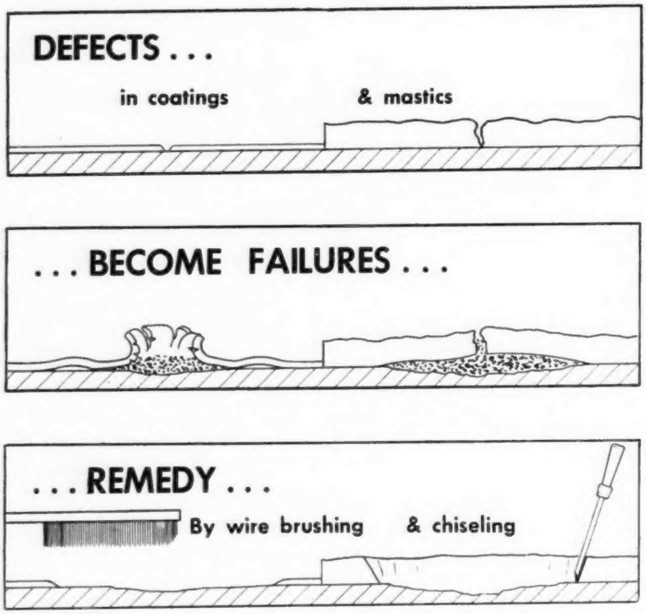
In the past the use of the word mastics has been closely associated with asphalt and coal tar materials, as these for many years were the only materials commonly available to meet mastic requirements. Within the last few years, however, mastic applications of vinyls, phenolics, polyethylene (by hot-melt or flame application), furanes, epoxys, and corrosion-retarding waxes and greases have become available.

Mastic materials are applied by heavy brush applications, by troweling, or by the use of spray guns utilizing the recently-developed compound pressure pump in place of the usual pressure pot. Their applied costs, as their usefulness, is intermediate between that of coatings and linings, varying from 75c. to $2 per sq. ft.

Mastics of bituminous base have long been in use where corrosion resistance has been combined with heat insulation. With this possible exception, current use of mastics lie predominately in Class I and Class II services (p. 149). As such they are special-purpose materials not normally recommended for general plant maintenance.

As with protective coatings, it is desirable to attain required mastic thicknesses in no less than three coats. This is to insure that there will be no coincidence of pinholes, capillaries, or exposed metal during application.

While it is possible to set up general minimum thickness specifications for protective coatings for general plant maintenance, the special service (Class I and Class II) uses require minimum thicknesses which vary not only with the nature of the mastic material, but also with the intended service. Such minimum thicknesses should be determined and specified



after consideration of the chemical, abrasive, and mechanical requirements for each use.

Surface design and surface preparation for application of mastics may be less critical than for the thinner protective coatings. Imperfect bond to the base metal over small areas can often be tolerated with the mastics, whereas such a condition would lead to early failure with the thinner protective coatings. For this reason, while sandblasting is always preferred and recommended for mastic applications, insistence is not made upon this point unless exposure conditions are unusually severe. It is essential, however, that all loose surface material, moisture, oil, and foreign matter be removed so that the mastic may be applied to tightly adherent and compatible surfaces.

Failure of mastic barriers, although by one of the same mechanisms which affect coatings, presents greater difficulty in effective repair. Assuming that the selection of the mastic material is proper, failure will occur at points where base metal is exposed during application or during subsequent use of the protective mastic barrier. At such points the metal will corrode, and if allowed to progress the mastic barrier will be undercut causing it to lose adhesion and peel or crack in expanding areas around the original metal exposure.

Progression of such undercoating corrosion will be more serious and exasperating than similar failure with thinner protective coatings. When such undercutting occurs with protective coatings it is relatively simple to simultaneously remove the corrosion product and the non-adherent paint film, and feather-edge the adherent paint film by simple wirebrush or blast application.

Such a simple procedure will not suffice with mastics. Due to their thickness, it will be necessary to cut away the non-adherent coating and to bevel the edges of adherent coating with a knife or heavy applications of a power wire brush. To avoid this expensive repair procedure it is especially important to detect corroding areas of bare metal at the outset and to repair such areas before appreciable undercutting has occurred.

Linings

Linings are defined as organic barriers of thicknesses no less than $\frac{1}{16}$ in. They are used against highly corrosive or abrasive environments. Owing to their relatively high applied costs ($1.75 to $4 per sq. ft.), they cannot usually be justified where base metal loss rates are less than 0.05 ipy.

Linings are also used in many instances where electrical currents, stray or imposed, will accelerate corrosion or otherwise interfere with normal operating processes. Usual minimum thickness specifications for rubber lining are $\frac{1}{8}$ in. and for vinyls, $\frac{3}{32}$ in. These may be considered safe minimum thicknesses for general corrosion work, although lesser thicknesses to $\frac{1}{16}$ in. may often be properly used.

With these lesser thicknesses, however, pre-trials should be made to determine suitability. Actually there is seldom any appreciable cost advantage in going to thicknesses less than $\frac{3}{32}$ or $\frac{1}{8}$ in. inasmuch as the greater part of the applied cost is the labor of application, and the savings in material by using a lesser thickness will be inconsequential.

Oldest applications of linings are with pitch, wood, and rubber—the latter applied as sheeting. Linings today are predominately applied as sheet stock inasmuch as the application cost is usually less with such material than by building up the required thickness by multi-coats of liquid applications. Such materials as vinyl plastisols, high solids rubber, and hot melt or flame spray applied plastics, resins and pitches are in considerable successful use.

In the application of heavy linings, surface preparation is not as critical as with protective coatings. However, service conditions which justify the use of these expensive linings are usually so severe that no compromise in quality of material or application is ever condoned. As a consequence sand or gritblasting is invariably used and design and elimination of surface irregularities is rigid.

Metal priming for linings is always required, but for the purpose of securing adhesion of the lining sheet to the base metal. Inhibitive materials are seldom incorporated in the primer, because against such aggressive corrosives the presence of these inhibitors would cause but insignificant retardation of underfilm corrosion once bare metal or the priming film were exposed. The only use of inhibitive primes is where the lining is primarily used for abrasion or mechanical resistances which do not necessarily require unbroken film continuity, and in which bare metal might occasionally be exposed to moisture or mild corrosives.

Each Basic Type Has Its Own Appeal

The hundreds of formulations suitable for chemical plant maintenance fall into a relatively few resin types. Here are the advantages and limitations of each.

Natural Rubber

In general chemical plant maintenance, rubber is in common use as molded articles, calendered sheet, and in some few cases as compounded rubber latex. The use of molded rubber articles is too well known to require discussion. Rubber-lined process equipment pipe and fittings are widely used throughout the chemical industry, in fact they constitute one of our oldest uses of organic materials in corrosion prevention. Such linings are normally applied in sheet form. In some instances, particularly with caustic tank cars, the linings may be applied by multiple coats of a suitably-compounded liquid rubber latex.

Natural rubber falls properly into the elastomer group. As it is normally applied in an incompletely-polymerized condition and polymerized by vulcanization after application, it has much in common with the thermosetting materials. The extent of final polymerization may be deliberately controlled so that the final barrier will be soft and resilient and therefore most suitable against highly abrasive conditions and mechanical injury, or it may be controlled so that the final barrier is a hard-rubber or ebonite with chemical resistance of the greatest universality.

The rubbers are resistant to all common inorganic acids and alkalis. They resist attack or softening by the lower alcohols but swell and become tender, often losing adhesion, when exposed to non-polar solvents such as hydrocarbons and ethers.

Natural rubber barriers have a top safe temperature limitation for normal services of about 150 deg. F. Depending upon compounding and state of polymerization they will either soften or harden, with possible cracking at sustained temperatures above this value.

The properties of rubber may be modified greatly by the wide choice of compounding, degree of vulcanization, and laminant reinforcing. Compounding includes wide choice in amount and type of accelerators, antioxidants, softeners, pigments and fillers (both reinforcing and extending). As a consequence rubber is usually compounded to characteristics most desirable for each end use.

Natural rubber is predominately used in the form of sheet linings for severe corrosive protection, generally in Class I exposures. It has a very considerable use in protecting equipment against abrasive wear. It is also widely used in this form for electrically isolating the base steel of the equipment from stray or imposed electrical currents. Use as thin coatings or as mastics has not yet attained appreciable magnitude.

Butadiene-Styrene Rubber (GR-S)

Butadiene-styrene rubber is the synthetic rubber development, spurred by the needs of World War II, designed to serve as the equivalent of natural rubber.

While chemically it is quite similar to the structure of natural rubber, there are significant differences. These differences are responsible for variances in physical and chemical properties from that of natural rubbers. The butadiene-styrene rubber is tougher and harder than its natural rubber equivalent. Natural rubber will chlorinate readily, and on exposure to muriatic acid will form a protective rubber hydrochloride surface film which formation is not evident in butadiene-styrene rubbers.

In general butadiene-styrene rubbers are as susceptible to property modification by the wide choice of compounding and processing as natural rubbers, and are used in the same manner and for the same purposes. In exposures involving contact with muriatic acid or hydrogen chloride natural rubbers are preferred.

As with natural rubber, principal chemical plant maintenance use of butadiene-styrene rubbers are in sheet forms as linings for process equipment, piping, and fittings. Their uses are for aggressive exposures of Class I services, abrasion-proofing, and the electrical isolation of equipment. Little or no use has been made industrially of these rubbers in the form of latices. Molded rubber articles are generally available.

Neoprene

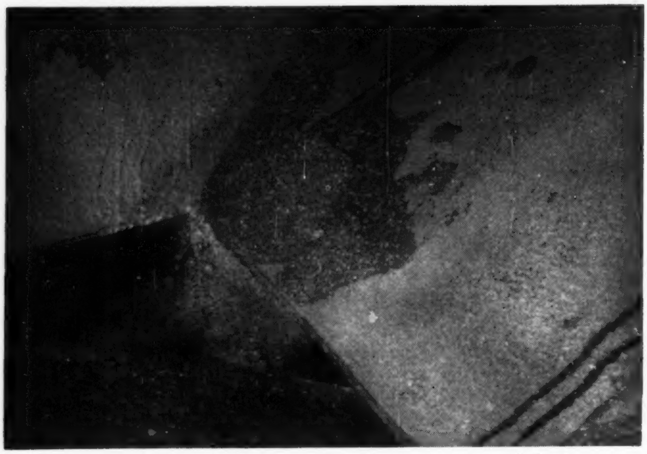
Neoprenes are synthetic rubbers of a chloroprene base. This chloroprene linkage gives neoprene barriers a resistance to hydrocarbons, heat, and oxidizing influences not generally characteristic of natural or butadiene-styrene rubbers.

In addition to possessing a wide universality of chemical resistance (including all common inorganic acids and alkalis, and considerable resistance to oxidizing agents), the neoprene materials are also resistant to aliphatic hydrocarbons and oils. They are swollen by chlorinated and aromatic hydrocarbons to such a degree that the adhesive bond is often impaired.

Neoprene is one of the few heat-resisting rubbers. Acrylonitrile rubber (not yet in wide industrial use) is another. Many chem-industrial uses of neoprene have been successfully performed at continuous temperatures to 250 deg. F. Satisfactory use of these rubbers at temperatures above 200 deg. F., however, should be predetermined by trial.

Neoprene compositions, like other rubbers, are susceptible to wide variation in properties due to compounding and processing. They require in their formulation vulcanizing materials, accelerators, antioxidants, softeners, fillers (both reinforcing and extending), and pigmentation. A wide range of rubber qualities may be produced which are best suited for any end use.

Neoprene is used in general industrial maintenance in sheet form as linings for process equipment, pipes, and fittings. Such linings can also be economically applied up to 3/16 in. from mastics which are currently available and which require the addition of a vulcanizing accelerator before application. This accelerator addition reduces the working time allowable for application, so that it will be necessary to accelerate only that quantity of material which can be applied within the working life of the admixture.



For two years, this neoprene barrier has withstood acidic corrosion and abrasion.

Diluted variations of these mastic compositions in various pigmentations are also available for high-build maintenance paint applications.

Due to the high build obtainable per coat and wide universality of of chemical resistance, these materials are coming into considerable use in Class II and III services.

Phenolics

Phenolic resins are basically condensation products of phenol and formaldehyde. They are thermosetting: hence coatings and linings must be polymerized after application. Such polymerization is usually accomplished by baking the applied coating at temperatures of 300-350 deg. F. Sometimes, particularly with casting compositions, the polymerization is carried out by the addition of a catalyst before application or casting. Baking is not required when a catalyst is used to carry out the polymerization.

Phenolic coatings are widely used as linings for process vessels and equipment where solvent resistance and resistance to temperatures up to 350 deg. F. are required. When applied as a coating from alcoholic solution, polymerization by catalysts has not proved practical and baking is always recommended. This limitation of baking precludes the use of this type of material for general plant maintenance and its use is therefore confined to special purpose uses which can justify the special techniques used during application. Application must be performed by specially trained technicians.

These coating compositions are not amenable to wide variations in compounding: compounding variations are normally limited to a narrow choice of types of phenolic bodies used in the condensation reaction, in pigmentation, and in solvent balance. This means that the properties and limitations of such baking phenolics from one manufacturer to another will not vary widely.

In general they have excellent resistance to all common inorganic acids. After polymerization they are completely resistant to all common solvents. They are infusible and inert at elevated temperatures up to 350 deg. F. They possess smooth, tough films of moderate abrasion resistance. They are, however, destroyed by exposure to all except very dilute caustics and alkalis, and have but little resistance to oxidizing agents.

Phenolic materials are normally dark in color, and therefore cannot be supplied in white or pastel colors.

Owing primarily to the need for voiding the water formed by the polymerization reaction, each coat cannot be applied in a thick film (dry coat thickness averages between ½-¾ mils). It is usually necessary to apply 5-7 coats to obtain the desired protection. Usually each coat is force-dried or partially polymerized before application of the succeeding coat.

In addition to the most common use of phenolics as chemical resistant baking finishes, such resins are also widely used to fortify oil-base paints to improve their water and chemical resistance.

Phenolic compositions are also available in non-volatile forms as casting liquids—from which fittings and other special articles may be made by casting into paraffin-coated plaster molds.

Considerable skill is required in casting to allow proper elimination of the water formed during polymerization, and to prevent excessive build-up of heat during the exothermic polymerization reaction. Many items of standard chemical plant equipment as well as special shapes and forms may be supplied by companies specializing in this work. These phenolic shapes or forms are filled with silica, asbestos, or graphite—depending upon end use.

Furanes

The furanes are very similar to the phenolics in their polymerization reaction and physical properties. They are condensation products of furfuryl alcohol and formaldehyde and form hard, tough films or masses of improved chemical resistance over the phenolics.

As with all condensation reactions water is formed during the polymerization process and must be eliminated during the reaction without disrupting film continuity or integrity of the coating or lining mass.

Polymerization is accomplished by mixing a catalyst with the material before application. This permits polymerization to proceed at normal atmospheric temperatures after application. This catalyst addition reduces the working life of the material. Only enough material should be mixed with catalyst that can be applied within its effective working life of a few hours. Polymerization can be accomplished without this catalyst addition by baking at temperatures in the range of 300-350 deg. F., although this procedure is not widely used with these materials.

Furane resins are thermosetting, and are therefore resistant to continuous exposures at temperatures up to 350 deg. F. Like the phenolics they are resistant, after polymerization, to all common inorganic acids and organic solvents. Unlike the phenolics they do possess a considerable resistance to caustics and alkalis and have a

greater latitude against oxidizing conditions than do the phenolics.

Variations in normal compounding practices are not wide, hence performances will be substantially equivalent regardless of supplier.

These materials are used in the same manner and for the same end uses as phenolics, although for lack of equivalent experience and long time use, their application techniques and experiences are not as well established. Their costs are somewhat higher than phenolics. In general their use is justified over the phenolics only when the additional universality of chemical resistance will justify the increased cost.

The furanes are available as coating compositions, applied in multiple coats of low build. They are also available as casting materials from which chemical resistant fittings, sheets, and other articles in standard chemical manufacturing use may be cast. Such castings are usually reinforced with silica, asbestos fiber, glass fabric, or graphite.

Epoxy Resins

Epoxy resins are quite similar to the phenolic resins in chemical structure and reaction, and are used in substantially the same manners and for the same uses. These resins are condensation products of polyphenols and epichlorhydrin. Being a condensation product water is liberated in the reaction and suitable provision must be made to eliminate this water during application so that the continuity or integrity of the coating film or mass may not be impaired.

They are available in coating compositions, as relatively non-volatile mastics, and as casting liquids.

Variations in normal compounding of the baking or catalyzed resins is confined principally to pigmentation and fillers. However, compounding with drying oils to produce air-drying coatings requiring no prior admixture of catalyst is so extensive that at times the characteristic properties of the epoxy resin are completely obscured.

Unlike both the phenolics and furanes they are available in light colors.

While the epoxys are a relatively new development, they are coming into widespread use. Their industrial performance, although satisfactory to date, is comparatively unexplored.

Oleo-Resinous Materials

We fully appreciate that we are leaving ourselves open to criticism by including the entire range of oleo-resinous materials within but one basic classification. There are many radically different types of formulations included within the general term "oleo-resinous paint," and these vary quite markedly in performance under various exposure conditions. However, this discussion is directed primarily to the use of protective coatings in the chemical industry and therefore the assumption of extreme and aggressive chemical atmospheres must be made.

Oleo-resinous materials have in common the presence of an unsaturated drying oil. These drying oils vary considerably in their nature and source, but all have their chemical structure of unsaturated glycerides. The oxidized films resulting from these oils are not noted for their chemical resistance, no matter how admirable they may be for atmospheric or marine exposures.

Chemical resistance is markedly improved by restricting ourselves to the harder oils (such as tung) and avoiding, except for mild exposures, the softer oils (such as fish or linseed). Further improvement in water and fume resistance results by fortifying these hard oils with varnishes of thermosetting resins, such as the phenolics and alkyds. Owing to the inherent lack of chemical resistance imparted by the drying oil, however, they are seldom advantageously used even in their most resistant formulations under service conditions more severe than Class IV, but they do find a wide and proper use in most Class IV services.

Within Class IV service areas, the usual protracted drying time required by these oil-base paints before overcoating will not usually be disadvantageous. In more severe chemical exposures, especially under certain aggressive fume conditions or under conditions of splash and spillage of corrosives, a required drying time of from 24 to 72 hr. will often result in incipient or complete destruction of the primer or intermediate coats before protective cover coats can be applied.

In Class IV services, however, the oil-base coatings possess advantages not generally found among the more chemical resistant synthetics.

First, both the material and applied costs are usually lower than either of these costs using synthetic systems. Prices of oleo-resinous coatings of suitable quality range from $2.50 to $5 per gal., as compared with the range of $4 to $8 per gal. for synthetic formulations.

Furthermore these oil-base formulations contain relatively low volatile content as compared with the average synthetic formulation. This means that it is usually possible to obtain a higher dry coating thickness per coat with oil base paints, thus obtaining the minimum recommended 5 mils thickness in fewer coats. Inasmuch as the labor cost of application is a considerable part of the total applied cost any reduction of number of coats applied will materially reduce these costs.

Second, the drying oil used in these formulations possess unique properties of wetability and penetrability not yet equalled with any of the synthetic formulations. These properties make this type of material very desirable for primes, and of particular advantage in coating imperfectly-prepared surfaces with minimum impairment of adhesion and serviceability.

Third, oil-base materials are relatively easy to apply according to techniques with which all industrial painters have been long accustomed. They brush out readily, and may be worked for a considerable period after initial application to the surface. Furthermore they do not evolve during application the considerable volume of unpleasant vapors which are usually encountered in the application of synthetics.

For these reasons oil-base formulations are normally preferred for all Class IV service areas wherever the exposure conditions within these areas permit their satisfactory use.

Oleo-resinous materials are available in all of the useful forms used in corrosion technology with the exception of molded and extruded parts. Sheet forms are available in the form of linoleum, but due to the limited chemical resistance of oleoresinous materials, such sheets are not used for equipment linings. Some mastics, composed essentially of a combination oleoresinous-bitumen base, have been used and have given excellent results. However, these are not in common

use. Thus the practical application of oleo-resinous materials in chemical plant maintenance is in the form of paint.

Vinyls

Vinyl materials are used very widely in chemical protection. They are basically copolymers of vinyl chloride and vinyl acetate, varying within a narrow range in the proportion in each of these.

In rendering vinyls, which are normally hard and brittle, to useful film-forming materials, it is necessary to add plasticizers. Amount and nature of these plasticizers will vary widely depending upon the manufacturer.

Incorporation of heat stabilizers is usually desired, and the final film characteristics will be similarly altered by choice of pigmentation.

Therefore it is evident that vinyl compositions will vary quite considerably, depending upon the extent and nature of its formulation. Performances and limitations discussed in the following, however, are basic with vinyl formulations and hold regardless of normal variations in compounding.

Vinyl resins are thermoplastic and are therefore susceptible to elevated temperatures, gradually softening and becoming tender as temperatures are increased. They are not recommended for use with continuous temperatures above 150 deg. F. Under certain conditions these temperatures may be safely exceeded, but suitability for higher temperatures should only be determined after trial. Softening of the material under elevated temperature is of value in making repairs to vinyl lining as the failing lining may be cut away from the sound film, the underlying surface cleaned and reprimed, and a vinyl patch fused into place to re-establish continuity and protection.

Vinyls basically possess a wide universality in resistance to various chemical exposures. They are fundamentally resistant to organic acids, alkalis and hydrocarbon vapors. They are softened or dissolved by aromatic and chlorinated hydrocarbons, esters, and ketones. While they have a greater resistance to oxidizing environment than most organic materials, they will fail ultimately by prolonged exposure to aggressive oxidizing agents.

Adhesion of vinyl coatings and linings to metal is always a problem and the search is still on for better adhesives and primes. Sandblasting is always desired as a surface preparation in the use of vinyls, although considerable progress has been made in overcoating inferior surfaces by the use of the recently developed wash prime system.

Principal current disadvantage of vinyls when used in protective coatings is their low build per coat. While it is true that per coat thicknesses up to 2 mils can be obtained by a trained operator through special techniques of double passes per coat, these techniques are not universally known to industrial painters. Coating thicknesses in the order of ¾ to 1 mil per coat are usually the rule. This means that it will require five to six coats to obtain the required 5-mil maintenance for general plant maintenance. Economics prohibit the use of this number of coats for general plant maintenance and therefore the use of such vinyl compounds is best restricted to special purpose use, such as equipment lining applications where such application costs can be justified.

Work is now in progress on the formulation of vinyl mastics and other formulations to increase the build. Such formulations have not been in existence for sufficient time to completely evaluate the extent of improvement.

The wide universality of resistance inherent in these materials makes it certain that they will attain a respectable position in general plant maintenance, as well as special purpose application—when and if the present physical limitations of adhesion and build are improved without detriment to chemical resistance.

Vinyl materials are presented to industry in a wide variety of forms. Injection moldings and extrusions are available for special shapes and fittings, as well as gaskets. Vinyl extruded tubing and corrosion resistant tapes are widely used. Vinyl sheet linings are commonly used in the lining of process equipment where greater range of chemical resistances are required than can be obtained by the usual sheet rubber linings.

Process equipment linings may also be applied in thicknesses from 1/16 to ¼ in. by the non-volatile liquid vinyl plastisols which require heating and a final baking at 350 deg. F. to complete their application. Heavy-build vinyl organosol coatings are also available which will give thicknesses up to 10 mils per coat, but unfortunately require baking for final fusion of the film.

Vinyl coatings in solvent solution are well known as chemical resistant protective coatings.

Vinylidene Chloride Copolymers

Vinylidene chloride copolymers are available as copolymers of vinylidene chloride with either vinyl chloride or acrylonitrile in varying proportions within narrow limits. In their properties and uses, and in chemical composition, they are quite similar to the vinyl materials.

They are currently available as uncured sheeting for the lining of tanks and process equipment by trained applicators in the field, as factory-lined piping and fittings which can readily be cut and assembled in the field by plant maintenance personnel following simple directions, and as protective coatings from both solvent and aqueous media.

Saran rubber, used in sheets for tank and process equipment lining, is an acrylonitrile copolymer. It possesses all of the characteristics of, and may be considered, a true elastomer. The copolymer with vinyl chloride is a true thermoplastic material and is principally used for protective coatings rather than equipment linings as are the vinylidene chloride–acrylonitrile copolymers.

These vinylidene chloride copolymers are basically resistant to most common inorganic acids and alkalis. While possessing a high degree of resistance to oxidizing agents, they will be adversely affected by prolonged contact with aggressive agents. While resistant to aliphatic hydrocarbons and oils, they are susceptible to swelling and possible loss of bond by certain organic solvents, especially of the higher ketones and esters.

The protective coating forms, while possessing excellent universality of chemical resistance, have the present defect of low thicknesses per coat, thus requiring considerably in excess of five coats for dependable protection. The high labor cost of such multi-coat applications preclude their general use for plant maintenance. Their serviceability is confined to special duty uses which will justify such application costs.

Chlorinated Rubbers

Chlorinated rubbers, as their name implies, are chlorination products of natural rubber.

While these materials are often correctly advertised as rubber-base coatings, there is a strong implication in such advertising that they possess the tensile and resilient properties of natural rubber. This is misleading, inasmuch as the chlorination product is tough and resinous and has no properties in common with the elastomers.

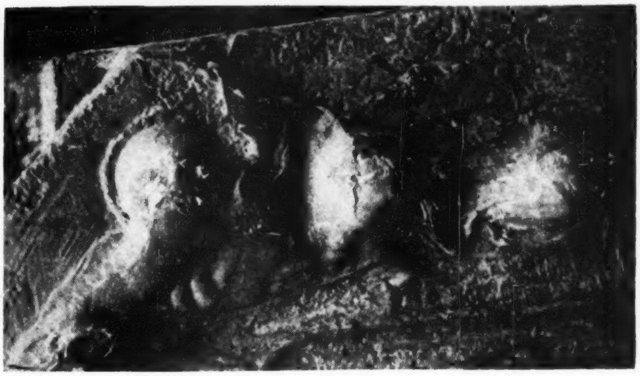
There is a rather widespread misconception that chlorinated bases are universal in their chemical resistance. This idea is so sufficiently widespread that many paint companies offer a full and diverse line of coatings for domestic and normal industrial exposures, and offer but a single chlorinated rubber system for the entire range of varied and aggressive chemical industrial exposures. Such systems usually bear all embracing designations as "chemical-resisting coatings" or "acid-alkali coatings."

While the chlorinated rubber coatings do possess a real place in chemical plant maintenance, they certainly are far from a universal "cure-all." They do possess a respectable resistance to alkalis and caustics and to some mineral acid exposures, but are susceptible to the fumes of non-polar organic materials such as hydrocarbons and ethers, and unless properly stabilized, have poor resistance to direct sunlight and oxidizing environment.

Their principal disadvantage for chemical plant maintenance is their low build. The volatile content of such coating compositions is very high. Hence normal industrial application yields between ½ and 1 mil per coat, thus requiring a minimum of five coats to equal or exceed the recommended safe 5 mils total system thickness.

Many manufacturers of this type of coating suggest that it may be safely used for chemical plant maintenance without a prior application of inhibitive prime. The low build characteristic of this material favors base metal exposure at surface irregularities, unless five or more coats are applied, and hence the use of inhibitive primes is imperative.

Conventional chlorinated rubber formulations found on the market today are suitable for general use only in Class IV service areas and may be safely used in such areas in place of oleoresinous coatings where the exposure is one of caustic or alkaline nature which would destroy an oleoresinous coating. Due also to their alkali-resistant properties, these materials are excellent coatings for concrete, resisting well the alkaline nature of the concrete surface.



Grease-type coatings used for temporary protection.

Chlorinated rubber materials are available for general plant maintenance only in the forms of coatings. No mastics, sheet, or special moldings or extrusions are available.

Several chlorinated rubber compounders are currently supplying heavy-build chlorinated rubber coatings. Such coatings show promise for successful and economical use in exposure conditions as severe as Class II and III services. They will, of course, also materially reduce the applied cost of such coatings. With these the recommended 5-mil system thickness can easily be built up with a maximum of three coats.

Styrene-Butadiene Resins

Styrene-butadiene copolymers, with a higher styrene ratio than is found in butadiene-styrene rubber, are available as resins which may be formulated into coatings. They are advertised as "rubber base coatings."

Like chlorinated rubber, such resins and coatings made from them possess no physical similarity to the elastomers. These compositions of styrene-butadiene base should not be confused with the similarly-advertised chlorinated rubber coatings.

From the standpoint of performance, styrene-butadiene coatings are quite similar to the chlorinated rubber coatings and in fact are competitive in use.

Like the chlorinated rubber coatings, the styrene-butadiene coatings are basically (from a material standpoint) resistant to considerable range of inorganic acids, caustics, and alkaline exposures. In their current formulations, however, they possess a very low build per coat, averaging for practical industrial applications, ½ to 1 mil. This low build necessitates a minimum of five coats to attain safe protective thicknesses.

Owing to their inherent alkali resistance, they may be properly used in Class IV exposures where alkaline contamination would adversely affect the oil-base paints which would normally be used in such service. For the same reason they find wide and useful application in the coating of concrete, resisting well the alkali lime of these surfaces.

Styrene-butadiene materials are currently available only as coatings.

Polyethylene

Polyethylene is a polymerized hydrocarbon which possesses unusual abilities in chemical resistance. The material is virtually unaffected by all common inorganic acids and alkalis, has greater resistance to oxidizing agents than any organic in appreciable use, and is unaffected by all common organic solvents. However, it is swelled slightly by the aromatic and chlorinated hydrocarbons.

It is a thermoplastic material, thereby softening at elevated temperatures. It should not be used at temperatures above 150 deg. F. without previous trials for suitability.

Unfortunately this material cannot be successfully applied today in the form of the conventional solvent or dispersion coatings. This confines its use to hot-melt mastic applications and to equipment liners made from sheet or extruded forms. Corrosion resistant self-adhering tapes are also available.

For mastic applications the material will build up very resistant films when applied to the metal surfaces by melting in the manner of dusting polyethylene powder onto a steel surface heated above the melting point of the polyethylene. Polyethylene powders can be also successfully handled through the variety of hot-air and flame guns currently available.

Unless pigmented in a black, polyethylene normally appears as a white, translucent solid. If applied by hot-melt technique it ranges from brown to black. It does not possess the extensibility or resilience of the elastomers, although it is quite flexible and resistant to impact and abrasion.

It resembles leather in its physical characteristics more than it does rubber. Like leather it has a high degree of flexibility and impact resistance in thin cross sections, but as the thickness is increased its flexibility and impact resistance is reduced.

Partially and fully-fluorinated derivatives of polyethylene are of considerable interest as temperature-resistant materials with high universality of chemical resistance. But these cannot as yet be applied with successful reliability as coatings, mastics, or sheet linings. Their principal chemical use at this time are in the form of molded or pressed gaskets.

Greases and Waxes

Saturated oils and waxes, usually of a paraffinic base, are chemically inert, and therefore have special applications in the coatings and mastic field. They resist successfully the action of most common inorganic acid fumes and are resistant to usual alkaline exposures.

Due to their soft wax-like or grease nature, they are usually temporary coatings; and should never be used where there is a possible contact with abrasion, mechanical impact or injury, or exposure to elevated temperatures. Where specifically formulated for corrosion service, inhibitive chemicals (usually chromates) are included in the formulation.

Bitumens

Bitumen compositions may be largely divided into two groups; those predominately of a coal-tar base, and those predominately of asphaltic base.

Often asphalt is mixed with varying proportions of mineral bitumens such as gilsonite or wurtzelite. Either coal-tar or asphalt materials may be obtained as solvent solutions or aqueous emulsions, although emulsion types are more generally found within the asphalt group.

Coal-tar compounds possess lower water permeabilities than those of asphalt bases, but the asphaltic compositions are more stable to weathering and direct sunlight. Asphaltic compositions also are available in a wider, although limited choice of colors.

These bituminous materials are widely ued as relatively low cost protection against acidic fume conditions in Class II and III areas and for general plant protection in Class IV areas. They are not particularly outstanding in their resistance to caustic or ammoniacal exposures, and such susceptibility is particularly marked in the cases of coatings deposited from emulsion.

The coal-tar compositions on prolonged exposure to weathering and direct sunlight slowly volatilize a portion of their natural plasticizer. Such volatilization causes shrinkage which becomes evident through surface checking or cracking, commonly known as alligatoring. Such shrinkage is not apparent with the asphalt base materials.

For this reason the recommended use for coal-tar base materials is in services protected from direct weathering and sunlight and they are at their best in sub-soil or immersion use.

The asphaltic materials, not possessing this disadvantage, are in wide successful use for general plant services even under direct weathering and sunlight exposure.

The coal-tar materials are available only in black, while the asphaltic materials are available as well in aluminum, and darker shades of gray, green, and red.

If confined to their proper use, these bituminous materials will give excellent performance. In considering their use, however, it is well to give considerable thought to the following:

First, these bitumen compositions are not compatible with other coating types. If other types are subsequently coated over bitumens, adhesion may be poor and peeling will quickly result—or bleeding of dark stains of the natural plasticizers in the bitumen will detract from the appearance of the overcoat.

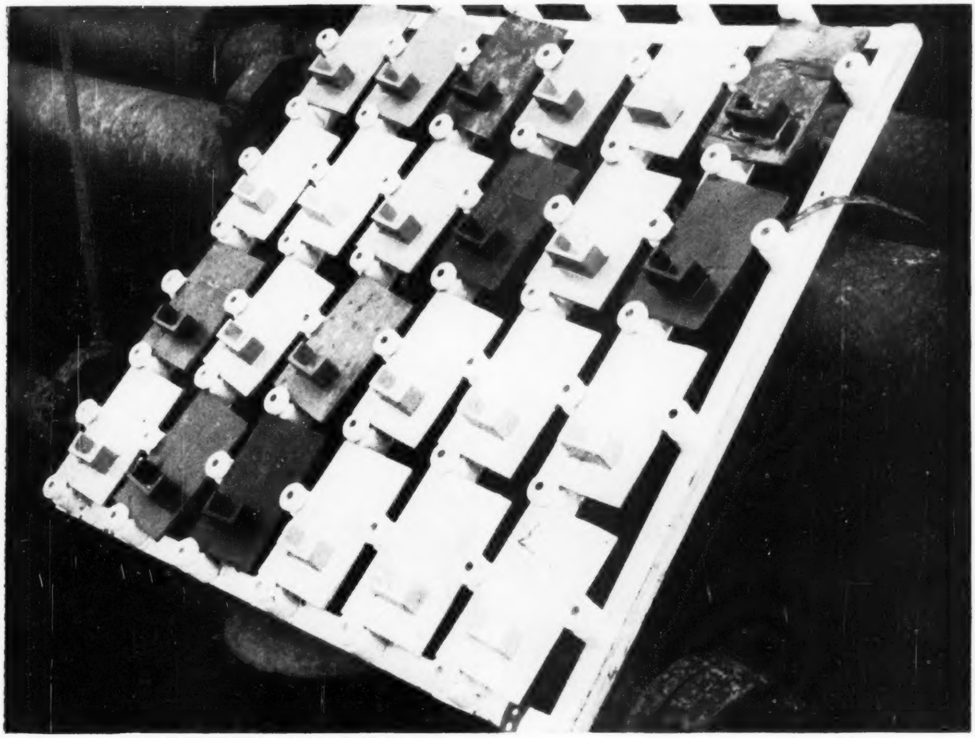
Secondly, the bitumen compositions usually apply in the mastic range from 15 mils to $\frac{1}{16}$ in. At any inadvertant point of exposed metal, corrosion will not be easily apparent from superficial surface inspection, and will proceed to undercutting of the film. Considerable undercutting will occur before it will be perceptible from the surface. By the time that failure is observable, protection in wide areas will have been lost and considerable sub-coating corrosion will have taken place. At this time repair of the failing coating will be no inconsiderable operation, requiring cutting away of the non-adherent coating by means of chisels, cleaning the corroded surface, and re-applying the coating composition over these areas.

The only effective way to avoid such an occurrence is to place such applications, immediately after application, on a regular system of scheduled inspection and maintenance, and wherever the first trace of rust staining is observed, indicating base metal exposure, the coating should be cut out at that point and renewed immediately before extensive undercutting can progress.

Summing up, while the performance of the bituminous coatings in their proper use is admirable, we must consider that it will be necessary to stay with this type of protection for at least ten years, and place the applied coating upon a rigid schedule of inspection and maintenance immediately after application.

Bitumen compositions may be obtained in solvent cut-back solutions which will yield thicknesses per coat approximating those of paint films. The greatest use of these materials, however, is in the form of mastic compositions where applied dry thicknesses will range between 15 mils and $\frac{1}{16}$ in. Such mastic applications are made from solvent solutions, aqueous emulsions, or by hot-melt applications.

One or two manufacturers are in a position to supply sheetings made from specially-compounded bituminous bases, although these are not in extensive use.



From Material Selection to Job Inspection

Selection and procurement, application, job and acceptance inspection, etc. are among the subjects requiring separate and more-detailed mention here.

The following section is devoted to important phases of this report which have been touched upon previously, but which require a more completely detailed treatment.

This section is written with paints and coatings primarily in mind, inasmuch as these constitute the greater use and volume of organic materials in the chemical industry. However, the same principles will also apply to mastics in most cases. They will constitute a valuable check list for consideration in application and procurement of linings as well.

Material Selection

In selecting protective coatings for chem-industrial use it is important to insure that the paint procured for that use will be suitable.

A long and successful record of experience in other industrial uses may not be sufficient if the intended use is in an aggressive chemical atmosphere. Pierce* has reported on a study made of 62 proprietary coating materials, each one of them with a long record of successful use in industrial plants. 42 percent of these materials failed rapidly when used in chem-industrial exposures.

Prior use is a contributory indication of possible successful performance, but only when the prior experience is in a similar chemical exposure to that under consideration. It will not suffice, however, to be content with only this evidence of probable useful performance, as any new application will have "strangers" in the atmosphere which may render the material performance variable in each new use. Wherever such assurance of prior successful use is available, a trial exposure test should be run to determine its suitability for the intended exposure.

Laboratory evaluation of material suitability should only be considered a weeding-out or elimination process. It is difficult, if not impossible, to duplicate the multiplicity and variety of corrosives which will prevail from time to time in the intended use area.

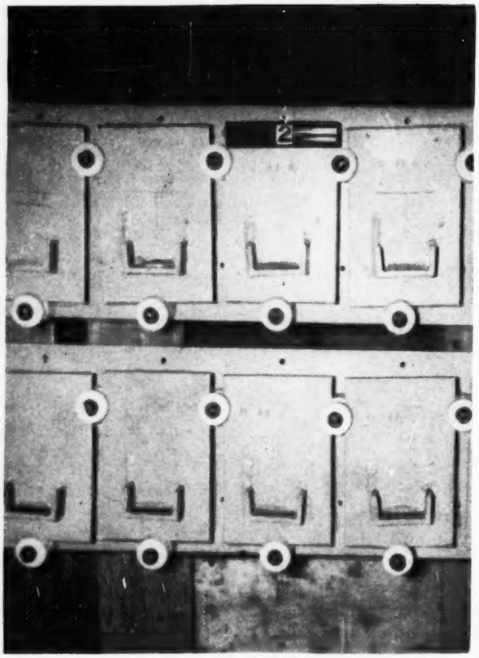
Selection of possible suitable materials should be determined only after consideration of available information and data regarding properties, performances, and limitations of various material types.

Once a selection of most promising types is made, formulations based upon these types should be solicited from various material manufacturers.

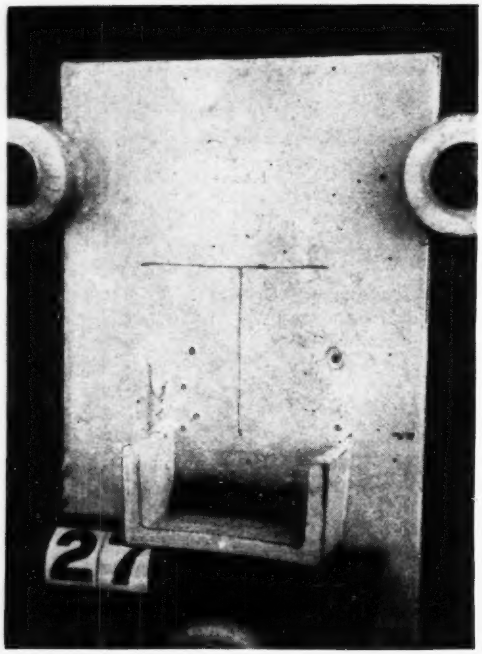
*Pierce, R., *Chem. Eng.*, May 1952, p. 149.

Test panels that reproduce common surface irregularities

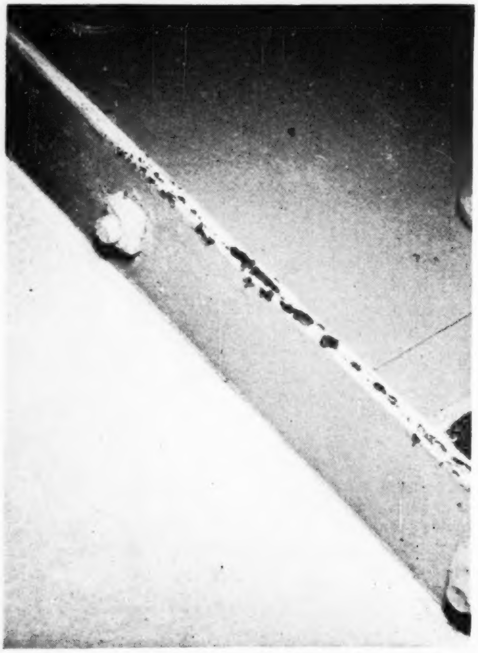
CORRODED test panels are given surface preparation before . . .



COATED panels are exposed on a rack in the service area.

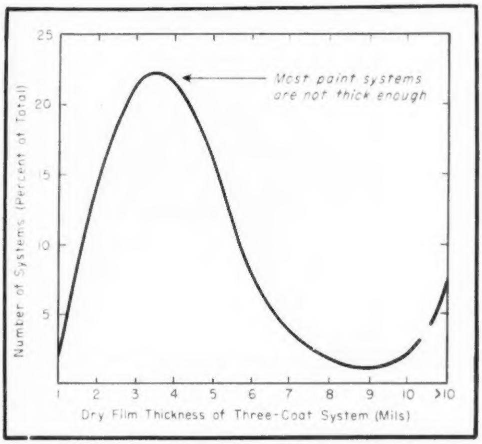


EXPOSED panels can predict types and sequences of . . .



FAILURE which in this case is over sharp edges, projections.

Chacteristics of System		System A	System B
Prime	Cost per gallon	....	\$5.50
	Coverage per gallon	....	250 sq. ft.
	Thickness per coat	....	0.5 mils
Body	Cost per gallon	\$5.00	\$7.25
	Coverage per gallon	200 sq. ft./gal.	150 sq. ft.
	Thickness per coat	1 mil	3 mils
Material cost per coat for prime		....	2.2¢
Material cost per coat for body		2.5¢	4.8¢
Number of coats to build up 5 mils		5	3
Paint thickness obtained		5 mils	6½ mils
Cost Per Square Foot			
Material		12.5¢	11.8¢
Surface preparation		15.0	15.0
Application labor		15.0	9.0
Scaffolding, misc.		0.5	0.5
Total direct applied cost		43.0¢	36.3¢



PROCUREMENT: Left—B at \$7¼ per gal. cheaper than A at \$5. Right—42% chance of 5-mil thickness with random buying.

Final selection from these submitted samples should be made, wherever possible, after applying a large patch of each coating system on representative equipment or structures in the intended use area. The surface covered by the patch should include all surface irregularities such as corners, edges, welds, pits, and crevices which will be encountered on the plant surfaces for which protection is desired.

Wherever the number of coatings to be tested are too numerous for such patch testing or where suitable or comparative equipment surfaces are not available, test panel exposure in the use area may be substituted providing such panels also reproducibly incorporate all surface irregularities to be encountered in the intended use. Such a panel has recently been described by the author* and is in wide and successful use throughout the chemical industry.

Material Procurement

As has been pointed out, the ideal plant maintenance coating system will be, for performance reasons, one which will readily yield thicknesses over the base corrodable metal of 5 mils or greater. For economic reasons it has also been demonstrated that such a coating will yield this minimum thickness in no more or no greater than three application coats.

Material manufacturers and suppliers have long recognized the value and desirability of these two requirements and from time to time in the past have offered coating systems to industry which would easily meet these requirements.

To such offerings industry has in the past turned a deaf ear. Consequently the coating manufacturers and suppliers have withdrawn these materials from their line for lack of sales, and set about to supply what industry apparently wants—which has proven to be materials of inferior protective life. Coating manufacturers will continue to supply industry with the type of products which industry asks for, and will buy. If these products are of poor quality and durability, it is the fault of industry and not the material supplier.

To obtain materials of better quality and durability, industry must learn what is needed to obtain these materials, ask for them, and back up their requests by purchases.

Traditional considerations in the procurement of protective coatings have concerned themselves simply with the price per gallon of the coating and how many sq. ft. of surface a gallon will cover. This is the yardstick by which material manufacturers have been asked to formulate and supply their materials.

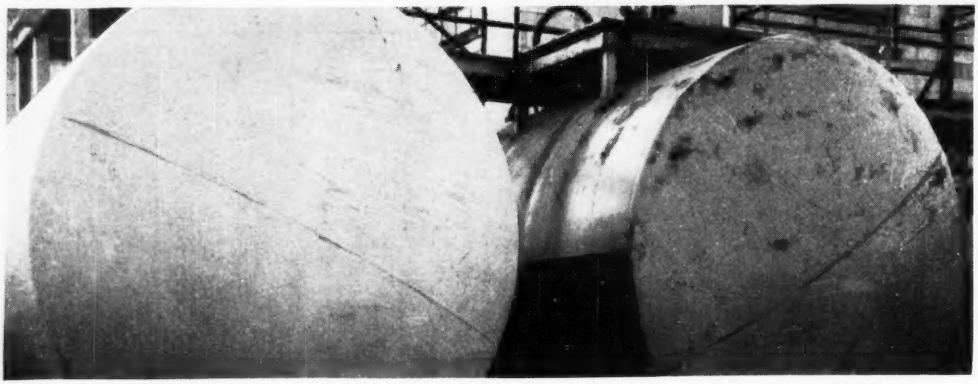
Lowering the cost per gallon can be accomplished in either or both of two ways: (1) by cheapening the film-forming oils, resins or other bases, pigmentation and modifying agents, and (2) by diluting these excessively by inexpensive thinners. High coverage per gallon can be obtained by thinning the formulation to such a great extent that the thickness of the dry film approaches molecular thicknesses. In other words high coverage can be obtained only at the expense of protective thickness.

To apply such cheapened and diluted compositions, which industry's procurement policies have encouraged the coating manufacturers to supply, to the recommended barrier thicknesses of 5 mils or greater requires an expensive multiplicity of coats. If such expense is not met the protective barrier film will be deficient in thickness, and only a short protective life will be obtained from each coating application. Pierce† has demonstrated that it may be less expensive to purchase and apply a high-quality material costing \$7.25 per gallon which only covers 150 sq. ft. per gallon, than it is to purchase material at \$5.00 per gal. which covers 200 sq. ft. per gallon. The savings are through lower labor cost required to attain the dependable 5 mils thickness and through the increased performance life obtained.

Labor costs of preparing surface to be coated and the labor of application in coating far exceed the cost of the coating material used. Labor costs can only be reduced in two ways: (1) by finding more efficient ways of properly preparing the surface for painting, and (2) by reducing the number of coats which need be applied to obtain the required protective thickness. At the present no immediate relief is in sight in regard to lowering

* Tator, K., *Chem. Eng.*, Oct. 1951, p. 140.

† Pierce, R., *Chem. Eng.*, May 1952, p. 149.



APPLIED TOO THIN is system on tank at right (3 mils dried film thickness). Left: 10 mils. Both chlorinated rubber, same area.

surface preparation costs. However, by asking for and deliberately procuring higher-solids, higher-consistency coating compositions, increased barrier thickness can be applied with each coat thereby reducing appreciably the number of coats required to obtain dependable thicknesses.

To supply materials of such body, however, means that the material manufacturer will have to substitute expensive film forming solids for part of the inexpensive thinners now used. This costs him additional money but in turn gives the user its equivalent in more film-forming solids. Gallonage prices of such higher build paints will therefore increase in proportion to the increase in non-volatile content. As each applied coat is now greater in thickness, obviously the material can no longer be spread as thinly and widely as formerly and the square foot coverage also will drop. This means that industry should be prepared to pay more money for proper material to realize a far greater savings in the labor of application and increased service life.

The policy of buying coating materials on the basis of cost per gallon and coverage per square feet has lost industry millions of dollars a year, in high labor costs and inadequate protection. It is high time that these procurement policies be discarded and the criteria of "minimum thickness per coat" be substituted.

Application Techniques

The average maintenance painter today has been brought up and well trained in the application of oil base paints, synthetics being relatively new.

As an oil base paint dries slowly by oxidation the painter has plenty of time to allow for prolonged working and brushing out of the wet film, such film being in entirely workable and fluid condition for up to an hour after application. It is therefore customary in the application of oil base paints to use a partially loaded brush and to brush the applied film out until the desired finish and placement is obtained.

If such an application procedure is used with a synthetic coating, and it usually is unless the painter has been specifically instructed otherwise, painter complaints and unsatisfactory performance will almost invariably result. As the synthetic material dries very rapidly by evaporation of volatile solvents, it is no longer possible to use the prolonged working or brushing out of the film after application.

If such brushing out is practiced with the synthetics, the applied film in becoming tacky will "grab" the brush and the painter will complain of its bad brushability, and that its consistency is too heavy.

If such a condition resulted from an oil base application, it would be corrected by adding a thinner. Consequently when such a situation develops, thinners are added to the synthetics in an attempt to prolong its brush life. The amount of thinner needed to give appreciable improvement in brushability is considerable. The end result is that the synthetic which is ordinarily designed to give from $\frac{3}{4}$ to $1\frac{1}{2}$ mils per coat actually yields between $\frac{1}{2}$ and $\frac{3}{4}$ mils per coat—thereby requiring an excessive number of costly paint applications to bring the total protective thickness up to the required minimum of 5 mils. It is therefore important that oil base techniques not be used when applying synthetic coatings.

The proper application for synthetic coatings is to use a fully loaded brush, to distribute the material quickly in one or two strokes over the surface, and then immediately smooth the applied coating out with cross strokes, using the tip of the brush only. This distribution should be finished within a few minutes after initial application, and the area coated at each time reduced to allow for finishing within this period. The drying film should not be re-worked or disturbed further.

This synthetic technique of application is very practical. Coating speeds and painter comfort can be maintained on the same level as with the application of oil base techniques as soon as the painter becomes skilled in the use of the technique.

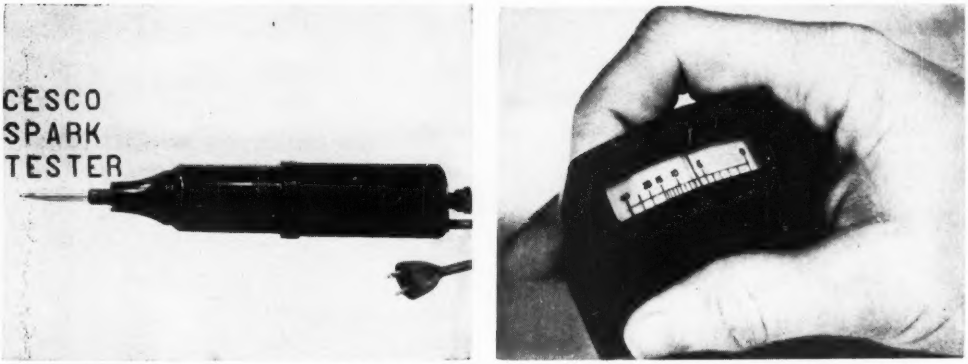
Job and Acceptance Inspection

As has been pointed out, the most economic protective life of coatings will be obtained only if certain requirements are rigidly adhered to. These requirements are:

1. Use of materials determined to be suitable for the intended exposure and use.

2. Surface preparation of the base steel to a quality economically consistent with the intended service conditions and coating materials.

3. Application of the material as directed by the manufacturer, or as has been found suitable by previous experience.



JOB INSPECTION is aided by electrical spark tester for testing continuity of applied barrier (left) and thickness gage (right).

4. Maintenance of proper drying times between coats.

5. Assurance that the finished dry coating thicknesses are uniformly and safely above the minimum thickness requirement for the application.

To obtain the superior paint performance which can be realized by observance of the above requirements, it is desirable to maintain inspections during the course of the paint application and before the application is released for service. Where the application is accomplished by the plant paint crew such inspection logically would fall on the shoulders of the paint foreman, who has been previously educated as to the need of maintaining such standards. Where the coating is done by outside contractors such inspection can again be performed by the plant paint foreman or an engineer assigned to this task.

Proper material use can be observed by noting the labeled or stenciled trade designation and manufacture on the original containers from which the coatings are withdrawn. This seems obvious but it is indeed surprising how many times improper paint materials have inadvertently been substituted in application.

Adequacy of surface preparation can be observed visually during or immediately after such preparation. After the surface has been properly prepared it is important that the first or priming coat be applied as soon after completion of surface preparation as possible in order that the surface does not revert, as it might do quickly, to a rusted or contaminated condition.

If the surface preparation does not include cleaning down to bright metal, it is desirable after surface preparation is completed and before any prime coat is applied to measure the thickness of any residual rust or residues on the surface to establish an average zero reading for the determination of subsequently applied coatings. After each coat has been properly applied, and this can be determined by observing the application, that coat is allowed to dry for the required drying period. After drying is complete and prior to application to the succeeding coat the measurement of the thickness of the applied coat should be determined and recorded and such determinations made after the application of each coat. Thickness of each of the coats will determine adequacies or deficiencies in any applied coat.

While total barrier thickness is important, the thickness composition within the barrier film is also important inasmuch as each coat serves a particular function and a deficiency in any one coat may affect the performance characteristics of the entire system. After the coating job is completed thickness determinations should be run to insure that the applied dried coating is safely and uniformly above the required minimum thickness.

If the barrier is to be used against corrosives which corrode the base metal at a rate greater than 0.05 ipy. the presence of any pinholes, discontinuities, or other access to bare metal should be determined. Determination of such points of exposed metal is made with an electrical spark tester for lining thicknesses of $\frac{1}{16}$ in. or greater. With care, such spark testers can be used even with mastics and coatings of lesser thicknesses.

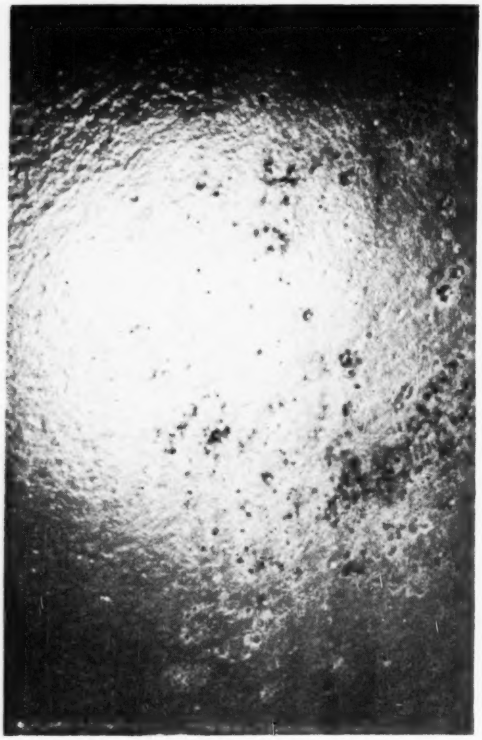
For such continuity testing of paint films ranging in thickness from 1 to 15 mils, an easily constructed electrical continuity tester is suitable. With this tester, an electrolyte solution is wiped onto the painted surface with a sponge. This sponge is connected by wire successively through dry cells and an indicating milliammeter or millivoltmeter, from which instrument a wire is connected to some point of exposed metal which is part of the base for the paint being tested. The electrolyte will penetrate any discontinuity or pores in the coating film, thereby completing the electrical circuit. The presence of discontinuities is indicated by the swing of the needle.

Regular Inspection and Maintenance

Establishment of a regular inspection and repair schedule for coating applications is one of the largest items of reduction of paint maintenance cost.

Pierce* has demonstrated that in an average paint application in chemical plant protection, the cost of surface preparation represented approximately one-half of the total cost of the paint application. This surface preparation operation consists essentially of obtaining a surface which is as clean as practical and free of all loosely adherent foreign matter, including rust and scale. Once such a surface is so prepared and overcoated with a well-selected paint there will be no opportunity, as long as this paint film remains intact, for the underlying surface to alter in any respect from the

* Pierce, R., *Chem. Eng.*, May 1952, p. 149.



INSPECTION of exposed surfaces tells when to touch up (left). Right: too far gone—needs complete surface preparation.

condition to which it was originally prepared. The only way in which the surface can revert to its original condition of contamination, foreign matter, and scale is for the barrier paint film to break—exposing the underlying metal to further corrosion.

If breaks in the paint film are repaired before appreciable corrosion has occurred it is obvious that there will be no further need for additional surface preparation for any future paint jobs over this same surface area, thereby saving the entire cost of surface preparation for each additional painting operation.

In these cases additional paint need be applied from time to time only to restore the desired original appearance of the coating, to compensate for paint thickness lost by wear or chalking, or to increase the total paint thickness safely above the 5-mil minimum. By this simple procedure of regular inspection and repair, chemical plant maintenance painting costs may be cut in half and reduced to as low as 6¢ per sq. ft. per year.

Records

Most industrial plants maintain records of their various paint applications.

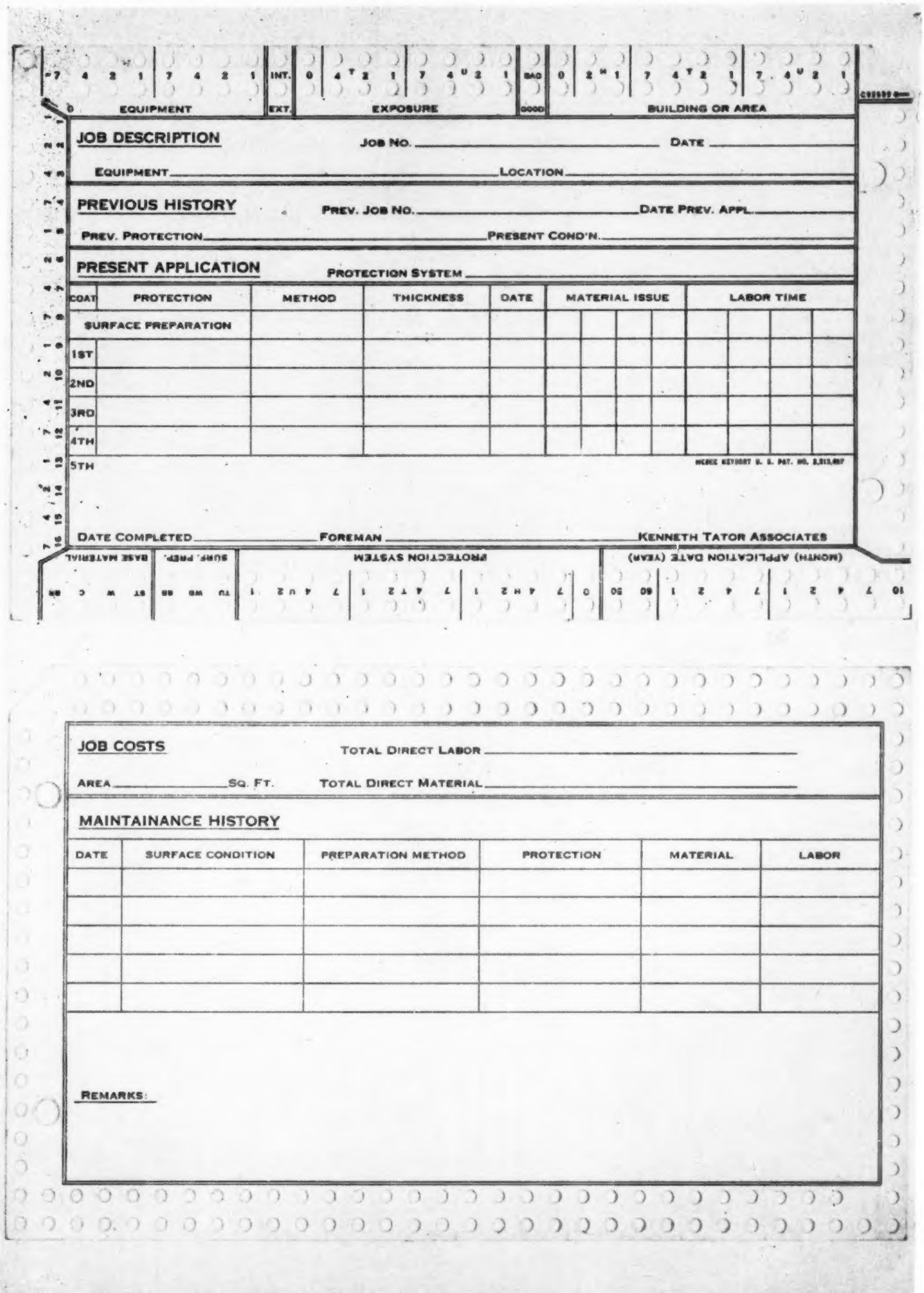
Obtaining specific information from these paint records, especially in regard to the cost of the paint application, is usually difficult and often impossible. The usual plant painting records religiously show the job number and some designation for the top coat applied. For the latter it is often the name of the supplier or an incomplete trade designation so that in future references to this job it is often impossible to exactly identify the material used.

Such records very seldom show the number of coats applied, the nature of the primer and intermediate coats, and the kind of surface preparation. Material disbursements to the job are usually shown, but the labor distribution for each paint job is normally lumped in with other construction and maintenance work carried on at the same time.

Where direct annual costs of painting run from $\$\frac{1}{4}$ to $\$\frac{1}{2}$ million per year, and this expenditure is common in many chemical plants, it is surprising that the accounting for these costs is so haphazard. Where annual expenditures of such magnitudes are involved, it seems only good business to positively know what applications have performed best under any exposure condition, the details of the surface preparation, priming, and number and nature of coats which are required to duplicate such superior performance for the future. In addition a record should be kept of the thickness of the applied coating for failure of otherwise excellent and desirable systems will occur only because the material was applied too thin.

Of greatest value, however, is the use of well-designed paint record system in the program of regular inspection and repair previously mentioned in this report.

Without such records, regular inspection cannot be properly scheduled nor the required repairs followed through.


EQUIPMENT | EXT. | INT. | EXPOSURE | GOOD | BAD | BUILDING OR AREA

JOB DESCRIPTION JOB NO. ____ DATE ____

EQUIPMENT ____ LOCATION ____

PREVIOUS HISTORY PREV. JOB NO. ____ DATE PREV. APPL. ____

PREV. PROTECTION ____ PRESENT COND'N. ____

PRESENT APPLICATION PROTECTION SYSTEM ____

COAT	PROTECTION	METHOD	THICKNESS	DATE	MATERIAL ISSUE	LABOR TIME
	SURFACE PREPARATION					
1ST						
2ND						
3RD						
4TH						
5TH						

McBEE KEYSORT U. S. PAT. NO. [illegible]

DATE COMPLETED ____ FOREMAN ____ KENNETH TATOR ASSOCIATES

BASE MATERIAL | SURF. PREP. | PROTECTION SYSTEM | (MONTH) APPLICATION DATE (YEAR)

JOB COSTS TOTAL DIRECT LABOR ____

AREA ____ SQ. FT. TOTAL DIRECT MATERIAL ____

MAINTAINANCE HISTORY

DATE	SURFACE CONDITION	PREPARATION METHOD	PROTECTION	MATERIAL	LABOR

REMARKS:

PAINT RECORD FORM—Top side: job identification; history and condition of previous coating, types of materials and application methods in current protection. Bottom side: record for periodic inspection of performance with types and cost of repairs.

Your Guide to Chemical Resistances

For any given basic resin type in use with a number of corrosives, you can find the exposures likely to permit satisfactory service.

The accompanying table is subject to the limitations in use of all such compilations.

In any chem-industrial exposure it is very rare that exposures are encountered which consist simply of corrosion by a single chemical. Usually chem-industrial exposures are complex exposures varying from time to time in the number and intensity of corrosives present.

This table should be used only as a preliminary selection of types.

After selection from the table and consideration of other available data, representative materials within these selected types should be obtained from the manufacturers. Final selection should be made only after actual trial in the intended use service.

This table of resistance is graded according to a system not heretofore used in such tables. The numerical evaluations of performance are not on the usual basis of "good," "indifferent," and "poor." Instead they represent the top class of chem-industrial service (see p. 149) in which these materials may be safely used. Obviously a material which is shown in the table as being in successful use in Class II services will also perform satisfactory in services of lesser severity, namely Class III and Class IV.

In use of the data in this table, all of the principles regarding proper use of organic materials (discussed elsewhere in this report) will apply. For example, if the base metal which we desire to protect is steel and the table shows an allowable Class I grading for the prospective coating types, the rate of corrosion of steel by the corrosive will determine whether this base type should be properly applied as a lining, mastic, or coating–according to the factors determining choice of thickness discussed in Section II.

It may be safely assumed, however, that in all Class IV areas coatings may be safely used; for although the corrosive agent may basically have a high corrosion rate, in the mild exposures prevailing in Class IV areas the corrosion rate will rarely exceed that requiring mastic or lining thicknesses.

Service area notations within the table are shown in Arabic numerals instead of Roman used elsewhere in this report.

	Natural Rubber	Butadiene-Styrene Rubber	Neoprene	Phenolics	Furanes	Epoxys	Oleoresinous	Vinyls	Vinylidene Chloride	Chlorinated Rubber	Styrene-Butadiene	Polyethylene	Bitumens
Acetaldehyde	1	2	1	1	1	1	3	2	2	3	3	2	3
Acetic acid, 10%	1	2	1	1	1	1	4	3	3	4	4	3	4
Acetic acid, glacial	1	2	1	1	1	1	4	3	3	4	4	3	4
Acetone	3	3	3	1	1	1	4	4	4	4	4	3	4
Alcohol, amyl	1	1	1	1	1	1	4	3	3	3	3	2	3
Alcohol butyl, normal	1	1	1	1	1	1	3	2	2	2	2	1	3
Alcohol, ethyl	1	1	1	1	1	1	2	1	1	1	1	1	2
Alcohol, isopropyl	1	1	1	1	1	1	2	1	1	1	1	1	2
Alcohol, methyl	1	1	1	1	1	1	2	1	1	1	1	1	2
Aluminum chloride	1	1	1	2	2	2	4	1	1	3	3	1	3
Aluminum sulphate	1	1	1	1	1	1	4	1	1	2	2	1	2
Ammonia, liquid	1	1	1	3	2	2	3	1		3	3	1	3
Ammonium chloride	1	1	1	1	1	1	3	1	1	3	3	1	2
Ammonium hydroxide	1	1	1	3	2	2	3	1		3	3	1	3
Ammonium nitrate	1	1	1	1	1	1	3	1	1	3	3	1	2
Ammonium sulphate	1	1	1	1	1	1	3	1	1	3	3	1	2
Aniline			2	3	2	2	4	4		4	4	2	4
Benzene	4	4	4	1	1	1	3	3	3	4	4	3	4
Boric acid	1	1	1	1	1	1	1	1	1	1	1	1	1
Butyl acetate	1	1	1	1	1	1	3	4	4	3	3	1	3
Calcium chloride	1	1	1	1	1	1	2	1	1	2	2	1	2
Calcium hydroxide	1	1	1	2	1	1	2	1	1	2	2	1	2
Calcium hypochlorite	1	2	2	3	2	2	4	1	1	2	2	1	3
Carbon disulphide	4	4	4	1	1	1	4	4	4	4	4	3	4
Carbon tetrachloride	4	4	4	1	1	1	4	4	4	4	4	4	4
Chlorine gas	1	2	2	4	4	4	4	2	1	4	4	3	4
Chlorobenzene	4	4	4	1	1	1	4	4	4	4	4	4	4
Chloroform	4	4	4	1	1	1	4	4	4	4	4	4	4
Chromic acid, 10%	2	2	2	4	3	3	4	2	2	4	4	2	4
Chromic acid, 60%	2	2	2	4	3	3	4	2	2	4	4	2	4
Citric acid	1	1	1	1	1	1	2	1	1	2	2	1	2
Copper sulphate	1	1	1	1	1	1	1	1	1	1	1	1	1
Diethyl ether	4	4	4	1	1	1	4	4	4	4	4	4	4
Ethylene glycol	1	1	1	1	1	1	2	1	1	1	1	1	2
Ferric chloride	1	1	1	1	1	1	3	1	1	3	3	1	3
Ferric sulphate	1	1	1	1	1	1	2	1	1	2	2	1	2
Formaldehyde, 40%	1	1	1	1	1	1	3	1	1	2	2	1	3
Formic acid, 20%	1	1	1	1	1	1	3	1	1	2	2	1	3
Formic acid, conc.	1	1	1	1	1	1	3	1	1	2	2	1	3
Gasoline	4	4	1	1	1	1	2	1	1	4	4	2	4
Glycerine	1	1	1	1	1	1	2	1	1	1	1	1	2
Hydrochloric acid, 10%	1	1	1	1	1	1	3	1	1	3	3	1	3
Hydrochloric acid, 30%	1	2	2	1	1	1	3	1	1	3	3	1	3
Hydrochloric acid, conc.	1	2	2	1	1	1	3	1	1	3	3	1	3
Hydrofluoric acid, 10%	1	2	1	1	1	1	3	2	2	2	2	1	2
Hydrofluoric acid, 40%	1	2	1	1	1	1	3	2	2	2	2	1	3
Hydrofluoric acid, 75%	1	2	1	1	1	1	3	2	2	2	2	2	3
Hydrogen peroxide, 3%	1	1	1	3	2	2	3	1	1	3	3	1	4
Hydrogen peroxide, 30%	2	2	1	3	2	2	3	2	2	3	3	3	4
Hydrogen sulphide	1	1	1	1	1	1	2	1	1	2	2	1	2
Hypochlorous acid	1	2	1	4	3	3	4	1	1	3	3	1	4
Kerosene	4	4	1	1	1	1	2	1	1	4	4	2	4
Lubricating oil	4	4	1	1	1	1	2	1	1	4	4	2	4
Magnesium sulphate	1	1	1	1	1	1	2	1	1	2	2	1	2
Methyl ethyl ketone	1	1	2	1	1	1	4	4	4	3	3	1	3
Mineral oil	4	4	1	1	1	1	2	1	1	4	4	2	4
Nitric acid, 5%	1	1	1	4	2	2	4	1	1	3	3	1	3
Nitric acid, 10%	2	2	1	4	2	2	4	2	2	3	3	1	3
Nitric acid, 40%	2	2	2	4	3	3	4	2	2	4	4	2	4
Nitric acid, conc.	3	3	2	4	3	3	4	2	2	4	4	2	4
Nitrobenzene	4	4	4	1	1	1	3	3	3	4	4	3	4
Oleic acid	3	3	2	1	1	1	3	2	2	4	4	2	4
Oxalic acid	1	1	1	1	1	1	2	1	1	2	2	1	2
Phenol, 15–25%			3	1	1	1							4
Phenol			3										4
Phosphoric acid, 10%	1	1	1	1	1	1	3	1	1	3	3	1	3
Phosphoric acid, 60%	1	1	1	1	1	1	3	1	1	3	3	1	3
Phosphoric acid, conc.	1	1	1	1	1	1	3	1	1	3	3	1	3
Potassium alum	1	1	1	1	1	1	2	1	1	2	2	1	2
Potassium hydroxide, 20%	1	2	1	4	2	2	4	1	1	2	2	1	3
Potassium hydroxide, 95%	1	2	1	4	2	2		1	1	2	2	1	3
Potassium permanganate	2	2	1	3	2	2	3	2	2	3	3	3	4
Potassium sulphate	1	1	1	1	1	1	2	1	1	2	2	1	2
Sea water	1	1	1	1	1	1	1	1	1	1	1	1	1
Silver nitrate	1	1	1	1	1	1	2	1	1	1	1	1	2
Sodium bisulphate	1	1	1	1	1	1	3	1	1	2	2	1	2
Sodium carbonate	1	1	1	4	2	2	4	1	1	2	2	1	4
Sodium chloride	1	1	1	1	1	1	1	1	1	1	1	1	1
Sodium hydroxide, 10%	1	2	1	4	2	2	4	1	1	1	1	1	3
Sodium hydroxide, 20%	1	2	1	4	2	2	4	1	1	2	2	1	3
Sodium hydroxide, 40%	1	2	1	4	2	2	4	1	1	2	2	1	3
Sodium hypochlorite	1	2	1	4	3	3	4	1	1	3	3	1	4
Sodium nitrate	1	1	1	1	1	1	2	1	1	2	2	1	2
Sodium sulphate	1	1	1	1	1	1	2	1	1	2	2	1	2
Sodium sulphite	1	1	1	1	1	1	2	1	1	2	2	1	2
Sulphur dioxide	1	1	1	1	1	1	2	1	1	2	2	1	2
Sulphuric acid, 10%	1	1	1	1	1	1	3	1	1	2	2	1	2
Sulphuric acid, 30%	1	1	1	1	1	1	3	1	1	3	3	1	3
Sulphuric acid, 60%	1	1	1	1	1	1	3	1	1	3	3	1	3
Sulphuric acid, conc.	2	2	2	1	1	1	3	2	2	3	3	1	3
Toluene	4	4	4	1	1	1	3	3	3	4	4	3	4
Trichloroethylene	4	4	4	1	1	1	4	4	4	4	4	4	4

Directory of Trade Names and Producers

This listing ties in proprietary products with basic resin types and forms available. For factors influencing choice of types and forms see pp. 147-162.

Material—Trade Name	Manufacturer	Address	Forms*
ACRYLIC			
Air Dry Lacquer	Atlas Coatings Corp	Long Island City, N. Y	C
Del Series B	David E. Long Corp	New York, N. Y	C
Lankote	J. Landau Co	Carlstadt, N. J	C
Prufcoat BX White	Prufcoat Laboratories, Inc	Cambridge, Mass	C
ASPHALT BITUMEN			
Acid Proof Black	Pratt & Lambert, Inc	Buffalo, N. Y	C
Aluminum Coatings	Protective Coatings Corp	Richmond, Calif	C
Apexior No. 3	Dampney Co	Boston, Mass	C
Asphalt Aluminum	Dux Paints & Chemicals, Inc	Lodi, N. J	C
Asphalt Paint	Protective Coatings Corp	Richmond, Calif	C
Atlastavon 10	Atlas Mineral Products Co	Mertztown, Pa	L
Carbalt	Heil Process Equipment Corp	Cleveland, Ohio	M
Conduct	Ralph V. Rulon, Inc	Philadelphia, Pa	L
Corulon	Ralph V. Rulon, Inc	Philadelphia, Pa	L
Duro-Ply	Electro Chemical Engineering & Mfg. Co	Emmaus, Pa	C, M
EC-1000	Minnesota Mining & Mfg. Co	Detroit, Mich	C
EC-1189	Minnesota Mining & Mfg. Co	Detroit, Mich	C
Emulastic	Ralph V. Rulon, Inc	Philadelphia, Pa	L
Kemo	Electro Chemical Engineering & Mfg. Co	Emmaus, Pa	M
Mortite	J. W. Mortell Co	Kankakee, Ill	M, L
Nu-Mastic	Nukem Products Corp	Buffalo, N. Y	M, L
Permite #8506	Aluminum Industries, Inc	Cincinnati, Ohio	C
Penncoat #101	Pennsylvania Salt Mfg. Co	Philadelphia, Pa	M
Plast-O-Line	Heil Process Equipment Corp	Cleveland, Ohio	M
Rulon Mastic	Ralph V. Rulon, Inc	Philadelphia, Pa	M
BUTADIENE—STYRENE			
Decco	Decatur Chemical Co	Decatur, Ga	C
Laybond H	Broadway Rubber Corp	Louisville, Ky	C
Tredon	C. A. Woolsey Paint & Color Co	New York, N. Y	C
BUTYL RUBBER			
Butyl	B. F. Goodrich Co	Akron, Ohio	L
Permobond GRI Soft	U. S. Rubber Co	New York, N. Y	L
CHLORINATED RUBBER			
Air Dry Lacquer	Atlas Coatings Corp	Long Island City, N. Y	C
Alka-Ceal	National Lacquer & Paint Co	Chicago, Ill	C
Alkatite	Pratt & Lambert, Inc	Buffalo, N. Y	C
Armorcoid	John L. Armitage & Co	Newark, N. J	C
Dampney	Dampney Co	Boston, Mass	C
Durachlor	Napko Paint & Varnish Wks	Houston, Tex	C
Dutch Boy 296-01	National Lead Co	New York, N. Y	C
Enamel M-1000	Raffi and Swanson, Inc	Chelsea, Mass	C
Ferrolastic	McDougall-Butler Co	Buffalo, N. Y	C
Fire Resist	Dux Paints & Chemicals, Inc	Lodi, N. J	C
Florhide	Pittsburgh Plate Glass Co	Pittsburgh, Pa	C
Heresite	Heresite & Chemical Co	Manitowoc, Wis	C
Hydroflex	Phelan-Faust Paint Mfg. Co	St. Louis, Mo	C
Lankote	J. Landau Co	Carlstadt, N. J	C
Moisture and Chemical Resisting Enamel	Lowe Bros. Co	Dayton, Ohio	C
Paralux	Allentown Paint Mfg. Co	Allentown, Pa	C
Parcrete	Paint Specialties, Inc	San Francisco, Calif	C
Pennpaint	Pennsylvania Salt Mfg. Co	Philadelphia, Pa	C
Ramuc	Inertol Co	Newark, N. J	C
Rexadur	Rexton Finishes, Inc	Irvington, N. J	C

* Forms available: C = coatings; M = mastics; L = linings. Coatings are considered here to be dried films less than 10 mils in thickness, mastics between 10 mils and 1/16 in., linings over 1/16 in.

Material—Trade Name	Manufacturer	Address	Forms*
CHLORINATED RUBBER (continued)			
Rubbercoat	Lambert Corp	Houston, Tex	C
Rubber-Hide	Dux Paint & Chemicals, Inc	Lodi, N. J	C
Rust-Oleum	Rust-Oleum Corp	Evanston, Ill	C
Teconite	Thompson & Co	Oakmont, Pa	C
Tnemec #700	Tnemec Co	North Kansas City, Mo	C
Torex	Inertol Co	Newark, N. J	C
Tornesit	Perry-Austen Mfg. Co	Grasmere, N. Y	C
Ucilon	United Chromium, Inc	New York, N. Y	C
Vorlac	Vorac Co	Rutherford, N. J	C
Zerok 125	Atlas Mineral Products Co	Mertztown, Pa	C
COAL TAR BITUMEN			
Bitex	Maurice A. Knight Co	Akron, Ohio	M
Bitulock	Continental Products Co	Euclid, Ohio	
Bitumarine	Baltimore Copper Paint Co	Baltimore, Md	C
Bitumastic	Koppers Co	Pittsburgh, Pa	M
Bituplastic	Koppers Co	Pittsburgh, Pa	M
Cermastic B-29	Continental Coatings Corp	New York, N. Y	M
Concoat 75	Continental Coatings Corp	New York, N. Y	C
Concoat Aluminum	Continental Coatings Corp	New York, N. Y	C
Conduct	Ralph V. Rulon, Inc	Philadelphia, Pa	L
Conseal	Continental Coatings Corp	New York, N. Y	C
Inertol	Inertol Co	Newark, N. J	C
Mastipitch	Ralph V. Rulon, Inc	Philadelphia, Pa	L
Reilly CA	Reilly Tar & Chemical Corp	Indianapolis, Ind	M
Rockcoat	Continental Coatings Corp	New York, N. Y	C
Tapecoat	Tapecoat Co	Evanston, Ill	Tape
Tnemecols	Tnemec Co	North Kansas City, Mo	C
EPOXY			
Amercoat No. 50	Amercoat Corp	South Gate, Calif	C
Copons	Coast Paint & Lacquer Co	Houston, Tex	C
Del Series D	David E. Long Corp	New York, N. Y	C
Epi-Rez	Jones-Dabney Co	Louisville, Ky	C
Epi-Tex	Jones-Dabney Co	Louisville, Ky	C
Ferrolastic	McDougall-Butler Co	Buffalo, N. Y	C
Fuse-On	Electro Chemical Engineering & Mfg. Co	Emmaus, Pa	C
Indubond No. 2-E	Industrial Lining Div., Chase Chemical Corp	Pittsburgh, Pa	C
Lankote	J. Landau Co	Carlstadt, N. J	C
Nitro-Dur	Electro Chemical Engineering & Mfg. Co	Emmaus, Pa	C
Pitt Chem 625	Pittsburgh Coke & Chemical Co	Pittsburgh, Pa	C
Porter	Porter Paint Co	Louisville, Ky	C
Vinoxy	Thompson & Co	Oakmont, Pa	C
Vorliner #44	Vorac Co	Rutherford, N. J	C
FURANE			
Alkaloy 550	Atlas Mineral Products Co	Mertztown, Pa	C, M
Ceilkote F-100	Ceilkote Co	Cleveland, Ohio	C
Duralon	U. S. Stoneware Co	Akron, Ohio	C
Formakote	Ralph V. Rulon, Inc	Philadelphia, Pa	M, L
Formalock	Ralph V. Rulon, Inc	Philadelphia, Pa	M, L
Jet-Kote	Furane Plastics, Inc	Glendale, Calif	C, M
Lankote	J. Landau Co	Carlstadt, N. J	C
Permanite	Maurice A. Knight Co	Akron, Ohio	M, L
MINERAL BITUMEN			
Ceilkote	Ceilkote Co	Cleveland, Ohio	C
Conolac	Continental Products Co	Euclid, Ohio	C
Insul-Mastic Vaporseal	Insul-Mastic Corp. of America	Pittsburgh, Pa	M
NATURAL RUBBER			
Acidseal E	B. F. Goodrich Co	Akron, Ohio	L
Acidseal MA	B. F. Goodrich Co	Akron, Ohio	L
Acidseal PA	B. F. Goodrich Co	Akron, Ohio	L
ARco Soft	Automotive Rubber Co	Detroit, Mich	L
ARco Soft	Arco Rubber Processors	Houston, Tex	L
ARco Hard	Automotive Rubber Co	Detroit, Mich	L
ARco Hard	Arco Rubber Processors	Houston, Tex	L

* Forms available: C = coatings; M = mastics; L = linings. Coatings are considered here to be dried films less than 10 mils in thickness, mastics between 10 mils and 1/16 in., linings over 1/16 in.

NATURAL RUBBER (continued)

Material—Trade Name	Manufacturer	Address	Forms*
Armorite	B. F. Goodrich Co	Akron, Ohio	L
Duro-Bond	Electro Chemical Engineering & Mfg. Co	Emmaus, Pa	L
EC-244	Minnesota Mining & Mfg. Co	Detroit, Mich	M, L
Hard Rubber—Heat Resistant*	Luzerne Rubber Co	Trenton, N. J	L
Hard Rubber Standard	Luzerne Rubber Co	Trenton, N. J	L
Heil #705	Heil Process Equipment Corp	Cleveland, Ohio	L
Indubond No. 200	Industrial Lining Div., Chase Chemical Corp	Pittsburgh, Pa	L
Laybond	Broadway Rubber Corp	Louisville, Ky	L
Linatex	Linatex Corp. of America	Rockville, Conn	L
Paramount	Paramount Rubber Co	Detroit, Mich	L
Permobond Natural Hard	U. S. Rubber Co	New York, N. Y	L
Permobond Natural Soft	U. S. Rubber Co	New York, N. Y	L
Pyroflex†	Maurice A. Knight Co	Akron, Ohio	L
Saniprene	B. F. Goodrich Co	Akron, Ohio	L
Superflexite	B. F. Goodrich Co	Akron, Ohio	L
Superflexite A	B. F. Goodrich Co	Akron, Ohio	L
Synco	Synco Corp	Emmaus, Pa	C, M, L

* Natural rubber & Buna-N synthetic. † Blend of natural rubber with other natural resins & fillers.

NEOPRENE

Material—Trade Name	Manufacturer	Address	Forms*
A-2389	B. F. Goodrich Co	Akron, Ohio	L
ARco	Automotive Rubber Co	Detroit, Mich	L
Brushing Compound #77	Union Bay State Chemical Co	Cambridge, Mass	C, M
Columbia #7 Lining	Pittsburgh Plate Glass Co	Pittsburgh, Pa	C, M
Duro-Prene	Electro Chemical Engineering & Mfg. Co	Emmaus, Pa	C, M
Duro-Prene HC	Electro Chemical Engineering & Mfg. Co	Emmaus, Pa	C, M
EC-539	Minnesota Mining & Mfg. Co	Detroit, Mich	C, M
Gaco Neoprene	Gates Engineering Co	Wilmington, Del	L
Gaco Neoprene N-200	Gates Engineering Co	Wilmington, Del	M, L
Gaco Neoprene N-700	Gates Engineering Co	Wilmington, Del	C
Gaco Neoprene Skidproof N-600	Gates Engineering Co	Wilmington, Del	C
Heil #722	Heil Process Equipment Corp	Cleveland, Ohio	L
Indubond No. 151	Industrial Lining Div., Chase Chemical Corp	Pittsburgh, Pa	C, M
Laybond N	Broadway Rubber Corp	Louisville, Ky	L
Maintenance Coatings #560	Union Bay State Chemical Co	Cambridge, Mass	C
Manhattan	Raybestos-Manhattan, Inc	Passaic, N. J	L
Neelium	Atlas Mineral Products Co	Mertztown, Pa	C, M
Neobons	Atlas Mineral Products Co	Mertztown, Pa	C, M
Paramount	Paramount Rubber Co	Detroit, Mich	L
Permaweld 1165	Polymer Chemical Co	Cincinnati, Ohio	
Permobond CRM Soft	U.S. Rubber Co	New York, N. Y	L
Proco	Protective Coatings, Inc	Tampa, Fla	C, M, L
Synco	Synco Corp	Emmaus, Pa	C, M, L
Trowelling Compound #254	Union Bay State Chemical Co	Cambridge, Mass	M

NITRILE RUBBER

Material—Trade Name	Manufacturer	Address	Forms*
Herecrol	Heresite & Chemical Co	Manitowoc, Wis	L
Permabond 1300	Polymer Chemical Co	Cincinnati, Ohio	L
Permobond GRA Soft	U.S. Rubber Co	New York, N. Y	L
Permobond GRA Hard	U.S. Rubber Co	New York, N. Y	L

PHENOLIC

Material—Trade Name	Manufacturer	Address	Forms*
Acikote	U.S. Stoneware Co	Akron, Ohio	C
Amercoat No. 77	Amercoat Corp	South Gate, Calif	C
Armorcote	John L. Armitage & Co	Newark, N. J	C
Ceilpor	Ceilkote Co	Cleveland, Ohio	C
Chemical Resistant Clear	Pratt & Lambert, Inc	Buffalo, N. Y	C
Cycloseal	Munray Products, Inc	Cleveland, Ohio	C
Durez	Durez Plastics & Chemicals	North Tonawanda, N. Y	C
Heil #486	Heil Process Equipment Corp	Cleveland, Ohio	C
Heresite	Heresite & Chemical Co	Manitowoc, Wis	C
Indubond No. 2	Industrial Lining Div., Chase Chemical Corp	Pittsburgh, Pa	C
Kabo	Maurice A. Knight Co	Akron, Ohio	C, M, L
Koraloy 470	Atlas Mineral Products Co	Mertztown, Pa	C
Lenkote	Industrial Coatings Corp	Chicago, Ill	C
Lining #640	Raffi and Swanson, Inc	Chelsea, Mass	C
Lithcote	Lithcote Corp	Chicago, Ill	C
Nukemite #88	Nukem Products Corp	Buffalo, N. Y	C
Permabond 1000	Polymer Chemical Co	Cincinnati, Ohio	C
Pitt Chem 502	Pittsburgh Coke & Chemical Co	Pittsburgh, Pa	C

* Forms available: C = coatings; M = mastics; L = linings. Coatings are considered here to be dried films less than 10 mils in thickness, mastics between 10 mils and 1/16 in., linings over 1/16 in.

Material—Trade Name	Manufacturer	Address	Forms*
PHENOLIC (continued)			
Prufcoat S.R.	Prufcoat Laboratories, Inc	Cambridge, Mass	C
Ricwilite #1060	Ric-Wil Plastic Coating & Mfg. Corp	Cleveland, Ohio	C
TK-2	Tube-Kote, Inc	Houston, Tex	C
Trailite	Trail Chemical Corp	El Monte, Calif	C
Tropelite	Tropical Paint & Oil Co	Cleveland, Ohio	C
Ucilon	United Chromium, Inc	New York, N. Y	C
Union	Union Chemical Corp	Newark, N. J	C
Vorliner #23	Vorac Co	Rutherford, N. J	C
PHENOLIC-DRYING OIL			
A & AR Varnish	Thibaut & Walker Co	Long Island City, N. Y	C
Bakelite 7313	Allentown Paint Mfg. Co	Allentown, Pa	C
Eisen-Heiss	Master Mechanics Co	Cleveland, Ohio	C
Flor-Deck	National Lacquer & Paint Co. Inc	Chicago, Ill	C
Hardcote	McDougall-Butler Co	Buffalo, N. Y	C
Heresite	Heresite & Chemical Co	Manitowoc, Wis	C
Lustercote Aluminum	Lehman Bros. Corp	Jersey City, N. J	C
Marblette 400	Marblette Corp	Long Island City, N. Y	C
Nelsonite R5	Nelsonite Chemical Products, Inc	Grand Rapids, Mich	C
Ox-O-Deck-Floor	Lehman Bros. Corp	Jersey City, N. J	C
Permite 2025	Aluminum Industries	Cincinnati, Ohio	C
Permite 2026	Aluminum Industries	Cincinnati, Ohio	C
Permite V-1000	Aluminum Industries	Cincinnati, Ohio	C
Pitt Chem 520	Pittsburgh Coke & Chemical Co	Pittsburgh, Pa	C
Resistant Enamel & Varnish	Pratt & Lambert, Inc	Buffalo, N. Y	C
Ricwilite	Ric-Wil Plastic Coating & Mfg. Corp	Cleveland, Ohio	C
Sanco	Monroe Sander Corp	Long Island City, N. Y	C
V65-122	Marblette Corp	Long Island City, N. Y	C
V65-4000	Marblette Corp	Long Island City, N. Y	C
V70-17	Marblette Corp	Long Island City, N. Y	C
POLYETHYLENE			
Polyken	Bauer & Black Div., Kendall Co	Chicago, Ill	Tape
Teflon*	Tube-Kote, Inc	Houston, Tex	C

* Fluorinated polyethylene.

Material—Trade Name	Manufacturer	Address	Forms*
SILICONE			
Aluminum 1500°	Dux Paints & Chemicals, Inc	Lodi, N. J	C
Dampney	Dampney Co	Boston, Mass	C
Del Aluminum #HH	David F. Long Corp	New York, N. Y	C
Hi-Heat	Warren Paint & Color Co	Nashville, Tenn	C
Lankote-Aluminum	J. Landau Co	Carlstadt, N. J	C
Permite #1901	Aluminum Industries	Cincinnati, Ohio	C
Porter	Porter Paint Co	Louisville, Ky	C
Prufcoat H.T	Prufcoat Laboratories, Inc	Cambridge, Mass	C
Silicone Aluminum	Allentown Paint Mfg. Co	Allentown, Pa	C
Thermalite	Tropical Paint & Oil Co	Cleveland, Ohio	C
STYRENE-BUTADIENE			
Acid & Alkali Resistant	Protective Treatments, Inc	Dayton, Ohio	C
Del Series F	David E. Long Corp	New York, N. Y	C
Duro-Kote #57	Electro Chemical Engineering & Mfg. Co	Emmaus, Pa	C
E-Z-Flow	McCabe Paint & Varnish Co	Irvington, N. J	C
Hydroseal	Thomson-Porcelite Paint Co	Philadelphia, Pa	C
Kling Koat	Thomson-Porcelite Paint Co	Philadelphia, Pa	C
Medusa	Medusa Portland Cement Co	Cleveland, Ohio	C
Nukemite #24	Nukem Products Corp	Buffalo, N. Y	C
P5	Watson-Standard Co	Pittsburgh, Pa	C
Pli-Namel	Glidden Co	Cleveland, Ohio	C
Prufcoat Standard	Prufcoat Laboratories, Inc	Cambridge, Mass	C
Satex	Hanline Bros	Baltimore, Md	C
Surface Saver	McCabe Paint & Varnish Co	Irvington, N. J	C
Synco 2100	Synco Corp	Emmaus, Pa	C
Tecoprene	Thompson & Co	Oakmont, Pa	C, M
Tropical	Tropical Paint & Oil Co	Cleveland, Ohio	C
UC-10340	Pittsburgh Plate Glass Co	Pittsburgh, Pa	C
Zerok 110	Atlas Mineral Products Co	Mertztown, Pa	C

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Material—Trade Name	Manufacturer	Address	Forms*
THIOKOL			
EC-1004	Minnesota Mining & Mfg. Co	Detroit, Mich	C, M
Permobond GRP Soft	U.S. Rubber Co	New York, N. Y	L
VINYL			
Acid & Alkali Resistant	Protective Treatments, Inc	Dayton, Ohio	C
Acid Causticbond	Wilbur & Williams Co	Boston, Mass	C
Air Dry Lacquer	Atlas Coatings Corp	Long Island City, N. Y	C
Amercoats	Amercoat Corp	South Gate, Calif	C
Armorhide	John L. Armitage & Co	Newark, N. J	C
Boltaron	H. N. Hartwell & Son, Inc	Boston, Mass	L
Bunatols	Nelson J. Quinn Co	Toledo, Ohio	C, M, L
Carlon	Vimasco Corp	Charleston, W. Va	C
Carhide	Pittsburgh Plate Glass Co	Pittsburgh, Pa	C
Ceilkote V-200	Ceilkote Co	Cleveland, Ohio	C
Chem-O-Lite	Jones-Blair Paint Co	Dallas, Tex	C
Corogards	Minnesota Mining and Mfg. Co	Detroit, Mich	C
Corrosite	Corrosite Corp	New York, N. Y	C
Cycloflex	Munray Products, Inc	Cleveland, Ohio	L
Cyclon	Munray Products, Inc	Cleveland, Ohio	C
Dampney	Dampney Co	Boston, Mass	C
Del Series A	David E. Long Corp	New York, N. Y	C
Duravin	Napko Paint & Varnish Wks	Houston, Tex	C
Duro-Kote	Electro Chemical Engineering & Mfg. Co	Emmaus, Pa	C
Dyna-Clad	Merchants Chemical Co	South Norwalk, Conn	C
Elastoplastic 396	Polymer Chemical Co	Cincinnati, Ohio	M, L
Flexseal	Protective Coatings, Inc	Tampa, Fla	C
Foamosol	Watson-Standard Co	Pittsburgh, Pa	C, M, L
Gaco Vinyl	Gates Engineering Co	Wilmington, Del	C
Grease Resistant	Paisley Products, Inc	Chicago, Ill	C
Heil #445	Heil Process Equipment Corp	Cleveland, Ohio	C
Heresite	Heresite & Chemical Co	Manitowoc, Wis	C
Insulbond No. 73-BX	Industrial Lining Div., Chase Chemical Corp	Pittsburgh, Pa	L
Kotol	U.S. Rubber Co	Naugatuck, Conn	C
Koroseal	B. F. Goodrich Co	Akron, Ohio	C, L
Koroseal	Raybestos-Manhattan, Inc	Passaic, N. J	L
Lankote	J. Landau Co	Carlstadt, N. J	C
Lanovin	J. Landau Co	Carlstadt, N. J	C
Laybond PVC	Broadway Rubber Corp	Louisville, Ky	L
Line-Tite	Plastic Lining Coatings, Inc	Chicago, Ill	L
Line-Tite VA	Plastic Lining Coatings, Inc	Chicago, Ill	C
Liquid Plastic	Plastic Coating Corp	Houston, Tex	C
Met-L-It	R. M. Hollingshead Corp	Camden, N. J	C
Metalasts	C. A. Woolsey Paint & Color Co	New York, N. Y	C
Miccroloid	Michigan Chrome & Chemical Co	Detroit, Mich	C
Miccrosol	Michigan Chrome & Chemical Co	Detroit, Mich	M, L
Miccrotape	Michigan Chrome & Chemical Co	Detroit, Mich	Tape
Miccrotex	Michigan Chrome & Chemical Co	Detroit, Mich	C
Nukemite #35	Nukem Products Corp	Buffalo, N. Y	C
Nukemite #40	Nukem Products Corp	Buffalo, N. Y	C
Panoflam	Perry-Austen Mfg. Co	Grasmere, N. Y	
Parakote Liners	Paramount Rubber Co	Detroit, Mich	M, L
PC-11 Plastisol	Munray Products, Inc	Cleveland, Ohio	M, L
Pee Vee	Thompson & Co	Oakmont, Pa	C
Permaskin	Dennis Chemical Co	St. Louis, Mo	C
Permawelds	Polymer Chemical Co	Cincinnati, Ohio	
Plastisols & Plastigels	Protective Treatments, Inc	Dayton, Ohio	M, L
PRS Mastics	Product Research Service, Inc	Westwego, La	M
Prufcoat "A"	Prufcoat Laboratories, Inc	Cambridge, Mass	C
Richardson #122	Richardson Paints, Inc	Havertown, Pa	C
Ridigsol	Watson-Standard Co	Pittsburgh, Pa	C, M, L
Sealon	Maurice A. Knight Co	Akron, Ohio	C
Sterilkote	Bradley & Vrooman Co	Chicago, Ill	C
Synco	Synco Corp	Emmaus, Pa	C
TK-43	Tube-Kote, Inc	Houston, Tex	L
Tuff	Nelson J. Quinn Co	Toledo, Ohio	C
Tuflex	Coating Materials Laboratories, Inc	Belleville, N. J	C
Tygon	U.S. Stoneware Co	Akron, Ohio	C
Tygoflex	U.S. Stoneware Co	Akron, Ohio	M, L
Tri-Guard	Benjamin Foster Co	Philadelphia, Pa	C
Ucilon	United Chromium, Inc	New York, N. Y	C

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Protective Coatings . . .

Material—Trade Name	Manufacturer	Address	Forms*
VINYL (continued)			
Unichrome	United Chromium, Inc	New York, N. Y	M, L
Union	Union Chemical Corp	Newark, N. J	C
U.S. Royalguard	U.S. Rubber Co	New York, N. Y	C
Vinco	Coating Materials Laboratories, Inc	Belleville, N. J	C
Vinrex	Rexton Finishes, Inc	Irvington, N. J	C
Vinyl	Lenoir Wood Finishing Co	Lenoir, N. C	C
Vinyl Aluminum	Dux Paints & Chemicals, Inc	Lodi, N. J	C
Vinyl-Clad	Plastic Lining Coatings, Inc	Chicago, Ill	C
Vinyl-Cote	Glidden Co	Cleveland, Ohio	C
Vinyl Floor Enamels	Benjamin Foster Co	Philadelphia, Pa	C
VinylLac	Plastic Lining Coatings, Inc	Chicago, Ill	C
Vinyl Plastisols	Atlas Coatings Corp	Long Island City, N. Y	M, L
Vinyl Red Lead	Dux Paints & Chemicals, Inc	Lodi, N. J	C
Vinyloid	Kelley-Mahorney Co	Louisville, Ky	C
Vinyltex	Baltimore Copper Paint Co	Baltimore, Md	C
Vinylux	Kelley-Mahorney Co	Louisville, Ky	C
Vorac	Vorac Co	Rutherford, N. J	C
Vorliner #22	Vorac Co	Rutherford, N. J	C
Zerok 101	Atlas Mineral Products Co	Mertztown, Pa	C
Zerok 105	Atlas Mineral Products Co	Mertztown, Pa	C
VINYLIDENE CHLORIDE			
Atlastavon 1	Atlas Mineral Products Co	Mertztown, Pa	L
Duro-San	Electro Chemical Engineering & Mfg. Co	Emmaus, Pa	L
Gaco Nitrocote	Gates Engineering Co	Wilmington, Del	C
Insulbond No. 100	Industrial Lining Div., Chase Chemical Corp	Pittsburgh, Pa	L
Naras Rubber	Broadway Rubber Corp	Louisville, Ky	L
Saran	Automotive Rubber Co	Detroit, Mich	L
Saran	ARco Rubber Processors	Houston, Tex	L
Saran	Lenoir Wood Finishing Co	Lenoir, N. C	L
Saran	Raybestos-Manhattan, Inc	Passaic, N. J	L
Saran Rubber	Dow Chemical Co	Midland, Mich	L
Saran Rubber	Saran Lined Pipe Co	Ferndale, Mich	L
Synco	Synco Corp	Emmaus, Pa	C, M, L
Tri-Bond	Broadway Rubber Corp	Louisville, Ky	L
Vorsans	Vorac Co	Rutherford, N. J	

* Forms available: C = coatings; M = mastics; L = linings. Coatings are considered here to be dried films less than 10 mils in thickness, mastics between 10 mils and 1/16 in., linings over 1/16 in.

Directory of Materials

The 4 Most Important Ways to Control Corrosion:

Your 15th Chemical Engineering Report on Materials of Construction

1. Inert Barriers (applied to supporting structure)
2. Corrosion-Resistant Structures
3. Corrosion Inhibitors
4. Cathodic Protection

For the 15th time we have polled the manufacturers of corrosion resistant materials of construction. As always they have responded nobly; it has taken 14 pages to list all the metals, carbonaceous materials, cements, ceramics, refractories, rubber products and plastics available to the corrosion engineer. Warning: The applications listed are intended to suggest, in a general way only, the field of greatest usefulness for the several materials. There is no implication, where, say, sulphuric acid is listed, that the material in question will withstand any temperature or concentration of the acid. Such limitations exist in every case; they have been omitted here because the intent has been general suggestion, not precise definition, of corrosion resistance.

METALS & ALLOYS

Materials	Manufacturer	Description	Most Important Applications
Admirality	Generally available.*	70 Cu; 1 Sn; 29 Zn	Fresh and salt waters.
Admiralty, Antimonial	Chase Brass & Copper Co., Waterbury, Conn.	71 Cu; 28 Zn; 1 Sn; 0.035 Sb	Corrosive waters, distillery liquors, petroleum products, salt brines.
Admiralty, Arsenical	Generally available.*	71 Cu; 28 Zn; 1 Sn; 0.04 As, Sb or P	Fresh and salt water, distillery liquors, petrol. prods.
Admiralty, Phosphorized	Scovill Mfg. Co., Waterbury, Conn.	71 Cu; 28 Zn; 1 Sn; 0.03 P	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, weak mineral acids.
Advance	Driver Harris Co., Harrison, N. J.	55 Cu; 45 Ni	
Alloy A	C. O. Jelliff Mfg. Co., Southport, Conn.	80 Ni; 20 Cr	Resistant to high temperature oxidation.
Alloy C	C. O. Jelliff Mfg. Co., Southport, Conn.	60 Ni; 15 Cr; bal. Fe	Resistant to acids and alkalis.
Alloy 45	C. O. Jelliff Mfg. Co., Southport, Conn.	55 Cu; 45 Ni	
Alloy K	C. O. Jelliff Mfg. Co., Southport, Conn.	22 Cr; 4.5 Al; bal. Fe	Resistant to high temperature oxidation and sulphurous atmosphere.
Alloy 1000	C. O. Jelliff Mfg. Co., Southport, Conn.	16.5 Cr; 24 Mn; 2.5 Mo; bal. Ni	
Aluminum, 99.6% Al	Generally available.†	99.6 Al	Foods, hydrogen peroxide, nitric acid, fermentation chemicals, beer and bev., essential oils.
Aluminum, 2S	Generally available.†	99.2 Al min.	Alcohol, naval stores, syn. resins and fibers, aldehydes, explosives.
Aluminum, 3S	Generally available.†	Al; 1.2 Mn	Atmosphere, foods, short chain aliphatics and their anhydrides, nitric and fatty acids, ammonium nitrate, esters.
Aluminum, 4S	Generally available.†	Al; 1.2 Mn; 1 Mg	Atmosphere.
Aluminum, Clad 3S	Generally available.†	3S clad with 72S (Al; 1 Zn)	Water, naval stores, sulphur and hydrogen sulphide.
Aluminum, Clad 4S	Generally available.†	4S clad with 72S (Al; 1 Zn)	Atmosphere, water, sulphur and hydrogen sulphide.
Aluminum, 52S	Generally available.†	Al; 2.5 Mg; 0.25 Cr	Atmosphere, foods, alcohols, naval stores, syn. resins and fibers.
Aluminum, 61S	Generally available.†	Al; 0.25 Cu; 0.6 Si; 0.25 Cr	Atmosphere, alcohols, ammonium nitrate, petroleum products, refrigerants, sulphur and hydrogen sulphide.
Aluminum, 24S	Generally available.†	Al; 4.5 Cu; 1.5 Mg; 0.6 Mn (also available in clad form where additional corrosion protection is required)	Atmosphere.
Aluminum, 63S	Generally available.†	Al; 0.4 Si; 0.7 Mg	Atmosphere, water, short chain aliphatics and their anhydrides, fatty acids, petroleum products.
Aluminum, Clad 53S	Generally available.†	53S (Al; 0.7 Si; 1.3 Mg; 0.25 Cr) clad with high purity Al	Synthetic resins, esters, aldehydes, beer and bev., soaps and cosmetics, essential oils.
Aluminum, 43	Generally available.†	Al; 5 Si	Atmosphere, water, short chain aliphatics and their anhydrides, fatty acids, naval stores, soaps.
Aluminum, 150S	Generally available.†	Al; 1.5 Mg (also available in clad form where additional corrosion protection is required)	Foods, alcohols, esters, petroleum products, syn. fibers.
Aluminum, 214	Generally available.†	Al; 3.8 Mg	Foods, alcohols, esters, petroleum products, syn. fibers.
Aluminum, B214	Generally available.†	Al; 3.8 Mg; 1.8 Si	Atmosphere, water, foods, ammonium nitrate, syn. resins, beer and bev.
Aluminum, 356	Generally available.†	Al; 7 Si; 0.3 Mg	Hydrogen peroxide, short chain aliphatics and their anhydrides, nitric acid, aldehydes, rubber, refrigerants.
Aloyco N-2 (Hastelloy "B")	Alloy Steel Products Co., Linden, N. J.	Ni; 26.0-30.0 Mo; 1.00 max. Mn; 1.00 max. Si; 0.07 max. C; 5.0-6.0 Fe; 0.25-0.50 V	All conc. quiescent aluminum chloride, zinc chloride; hydrochloric, sulphuric, acetic, and phosphoric acids.
Aloyco N-3 (Hastelloy "C")	Alloy Steel Products Co., Linden, N. J.	Ni; 15-17 Cr; 16-18 Mo; 3.75-5.25 W; 4.5-7.0 Fe; 0.07 C; 0.2-0.4 V; 1 max. Mn; 1 max. Si	Bromine (wet), chlorine gas (saturated vapor). Hypochlorite solns., free chlorine, sulphuric acid.
Aloyco-20	Alloy Steel Products Co., Linden, N. J.	19–21 Cr; 28–30Ni; 3.5–4.5 Cu; 2.0–3.0 Mo; 1.00 max. Si; 1.00 Mn; 0.07 max. C; bal. Fe	Acetic acid, 25% nitric acid, 75% sulphuric acid at boiling, 5% nitric acid, 30% sulphuric acid at boiling, 10% sulphuric acid and 2% ferric sulphate at boiling, ammonium sulphate, conc. citric acid, 10% sodium sulphite, all concentrations of sulphuric acid, conc. lactic acid.
Aloyco 35	Alloy Steel Products Co., Linden, N. J.	24–26 Cr; 19–21 Ni; 2.75–3.25 Mo; 1.00 max. Mn; 1.00 max. Si; 2.5–3.5 Cu; 0.07 max. C; bal. Fe	Sulphuric, acetic, phosphoric, fatty acids; sulphuric acid plus hydrocarbons.
Alumel	Hoskins Mfg. Co., Detroit, Mich.	94 Ni; 4 Al; 1 Si; 1 Mn	
Ambraloy 901	Amer. Brass Co., Waterbury, Conn.	95 Cu; 9 Al	
Ambraloy 917	Amer. Brass Co., Waterbury, Conn.	82 Cu; 9½ Al; 5 Ni; 2½ Fe; 1 Mn	
Ambraloy 927	Amer. Brass Co., Waterbury, Conn.	76 Cu; 21.96 Zn; 2 Al; 0.04 As	
A Metal	Midvale Co., Philadelphia, Pa.	Fe; 19 Cr; 35 Ni; 0.35 C; 1 Si; 0.5 Mn	
AMF	Midvale Co., Philadelphia, Pa.	Fe; 46-50 Ni; 0.1-0.2 C; 1-2 Mn	
Ampco 8	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 6.0-8.0 Al; 1.5-3.0 Fe	Sulphuric, acetic, citric acids; sodium chloride; alcohols; hydrocarbons.

NOTE: Many of the names listed here in the "Materials" column are trademarks and are not to be understood by presentation here to denote generic or descriptive names for general use.

* "Generally available" copper alloys may be obtained from such companies as the following: American Brass Co., Waterbury, Conn.; American Metal Co., New York, N. Y.; Ampco Metal Inc., Milwaukee, Wis.; Bridgeport Brass Co., Bridgeport, Conn.; Bristol Brass Co., Bristol, Conn.; Chase Brass & Copper Co., Waterbury, Conn.; Mueller Brass Co., Port Huron, Mich.; New England Brass Co., Taunton, Mass.; Phelps Dodge Copper Products Corp., New York, N. Y.; Revere Copper & Brass, Inc., New York, N. Y.; Riverside Metal Co., Riverside, N. J.; Scovill Mfg. Co., Waterbury, Conn.; Seymour Mfg. Co., Seymour, Conn.; Wolverine Tube Co., Detroit, Mich.

† "Generally available" aluminum and aluminum alloys can be obtained from Aluminum Co. of America, Pittsburgh, Pa.; Reynolds Metals Co., Louisville, Ky.; Kaiser Aluminum & Chemical Corp., Chicago Ill.

Materials	Manufacturer	Description	Most Important Applications
Ampco 12	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 8.0–9.5 Al; 2.25–3.25 Fe	
Ampco 15	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 8.5–10.0 Al; 2.50–3.75 Fe	
Ampco 16	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 9.30–10.30 Al; 2.75–4.0 Fe	
Ampco 18	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 10.00–11.2 Al; 3.0–4.25 Fe	
Ampcoloy 40	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 9.5–10.5 Al; 0.20 max. Fe	
Ampcoloy 45	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 9.7–10.9 Al; 2.0–3.5 Fe; 4.5–5.5 Ni; 1.5 max. Mn	Sulphuric, acetic, citric acids; sodium chloride; alcohols; hydrocarbons.
Ampcoloy 62	Ampco Metal, Inc., Milwaukee, Wis.	55–60 Cu; 0.5–1.5 Al; 0.4–2.0 Fe; 1.5 max. Mn; 1.0 max. Sn; 0.4 max. Pb; 0.5 max. Ni; bal. Zn	
Ampcoloy 66	Ampco Metal, Inc., Milwaukee, Wis.	60–68 Cu; 3–7 Al; 2–4 Fe; 2.5–5 Mn; 0.5 max. Sn; 0.2 max. Pb; 0.5 max. Ni; bal. Zn	
Ampcoloy A3	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 9–10 Al; 1.50 max. Fe	
Ampcoloy E123	Ampco Metal, Inc., Milwaukee, Wis.	Cu; 9.5–11 Al; 1.5 max. Fe	
Antaciron	Worthington Pump & Machinery Corp., Harrison, N. J.	Fe; 14.5 Si	Sulphuric acid slurries (under reducing conditions); hydrochloric, sulphuric acids; acid chlorides; stray current conditions.
Apex 417	Apex Smelting Co., Chicago, Ill.	Al; 7 Mg	Atmosphere, water, most neutral organic or aqueous solutions, foods, beverages.
Asarco Acid Lead	Amer. Smelting & Ref. Co., New York, N. Y.	Pb; 0.06 Cu; 0.025 Bi; 0.002 Ag; 0.001 Zn; 0.002 Fe	Sulphuric, sulphurous, phosphoric, chromic, hydrofluoric acids.
Berylco 10	Beryllium Corp., Reading, Pa.	Cu; 0.45–0.60 Be; 2.35–2.60 Co	Corrosive atmospheres, fresh and salt waters, weak alkalis and mineral acids.
Berylco 25	Beryllium Corp., Reading, Pa.	Cu; 1.80–1.95 Be; 0.20–0.35 Co	Corrosive atmospheres, fresh and salt water, weak alkalis and mineral acids.
Berylco 50	Beryllium Corp., Reading, Pa.	Cu; 0.25–0.50 Be; 1.40–1.70 Co; 0.90–1.10 Ag	Corrosive atmospheres, fresh and salt waters, weak alkalis and mineral acids.
Berylco 165	Beryllium Corp., Reading, Pa.	Cu; 1.60–1.80 Be; 0.20–0.35 Co	Corrosive atmospheres, fresh and salt waters, weak alkalis and mineral acids.
Berylco 10C	Beryllium Corp., Reading, Pa.	Cu; 0.55–0.70 Be; 2.35–2.60 Co	Corrosive atmospheres, fresh and salt waters, weak alkalis and mineral acids.
Berylco 20C	Beryllium Corp., Reading, Pa.	Cu; 2.00–2.20 Be; 0.35–0.60 Co	Corrosive atmospheres, fresh and salt waters, weak alkalis and mineral acids.
Berylco 275C	Beryllium Corp., Reading, Pa.	Cu; 2.60–2.85 Be; 0.35–0.60 Co	Corrosive atmospheres, fresh and salt waters, weak alkalis and mineral acids.
Brass, Aluminum	Generally available.*	76 Cu; 22 Zn; 2 Al	Sea and harbor waters, distillery liquors, petrol. prods.
Brass, Antimonial Aluminum	Chase Brass & Copper Co., Waterbury, Conn.	77.5 Cu; 20.5 Zn; 2 Al; 0.035 Sb	Sea and harbor waters, distillery liquors, petrol. products.
Brass, Cartridge	Generally available.*	70 Cu; 30 Zn	Corrosive atmospheres, salt water, weak alkalis.
Brass, Forging	Generally available.*	60 Cu; 2 Pb; bal. Zn	Corrosive atmospheres, salt water, weak alkalis.
Brass, Free Cutting	Generally available.*	61.5 Cu; 3 Pb; bal. Zn	Corrosive atmospheres, salt water, weak alkalis.
Brass, High	Generally available.*	66 Cu; 34 Zn	
Brass, Low	Generally available.*	80 Cu; 20 Zn	Corrosive atmospheres, hot and cold fresh water, salt water, organic acids, weak alkalis.
Brass, Low Leaded	Generally available.*	67 Cu; 0.5 Pb; bal. Zn	Corrosive atmospheres, salt water, weak alkalis.
Brass, Med. Leaded	Generally available.*	64.5 Cu; 1.0 Pb; bal. Zn	Corrosive atmospheres, salt water, weak alkalis.
Brass, High Leaded	Generally available.*	63 Cu; 2.0 Pb; bal. Zn	Corrosive atmospheres, salt water, weak alkalis.
Brass, Red	Generally available.*	85 Cu; 15 Zn	Acid sludge lines in oil refineries, salt and fresh water, non-oxidizing acids.
Brass, Tin	Generally available.*	92 Cu; 1 Sn; 7 Zn	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, organic and weak mineral acids.
Bronze, Aluminum	Generally available.*	82–95 Cu; 5–10 Al; Fe; Mn; Ni; Sn	Sulphuric, acetic, citric acids, sodium chloride; hydrocarbons; distillery liquors, fresh and salt water.
Bronze, Aluminum Silicon	Bridgeport Brass Co., Bridgeport, Conn.	91 Cu; 7 Al; 2 Si	Water, non-oxidizing acids, atmosphere.
Bronze, Commercial	Generally available.*	90 Cu; 10 Zn	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, organic and weak mineral acids.
Bronze, Commercial, Leaded	Generally available.*	89 Cu; 1.75 Pb; 9.25 Zn	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, organic and weak mineral acids.
Bronze, 600 Forgeable Bearing	Mueller Brass Co., Port Huron, Mich.	58 Cu; 37 Zn; 5 Hardener	
Bronze, 603 Forgeable Bearing	Mueller Brass Co., Port Huron, Mich.	58 Cu; 36 Zn; 1 Pb; 5 Hardener	
Bronze, Hardware	Scovill Mfg. Co., Waterbury, Conn.	89 Cu; 8 Zn; 2 Pb; 1 Ni	
Bronze, High Leaded Tin	Mueller Brass Co., Port Huron, Mich.		
Bronze, Manganese	Mueller Brass Co., Port Huron, Mich.	58 Cu; 36 Zn; 1 Pb; 5 Hardener	
Bronze, Maganese	Bridgeport Brass Co., Bridgeport, Conn.	58.5 Cu; 1.0 Fe; 0.3 Mn; bal. Zn	
Bronze, High Strength Manganese	Mueller Brass Co., Port Huron, Mich.	65.3 Cu; 3 Fe; 4.5 Al; 3.7 Mn; Zn	
Bronze, Olympic, Type A	Chase Brass & Copper Co., Waterbury, Conn	96 Cu; 3 Si; 1 Zn	Pickling acids and salt brines.
Bronze, Olympic, Type B	Chase Brass & Copper Co., Waterbury, Conn.	97.5 Cu; 1.5 Si; 1 Zn	Pickling acids and salt brines.
Bronze, Phosnic	Chase Brass & Copper Co., Waterbury, Conn.	98.75 Cu; 1 Ni; 0.25 P	Corrosive atmospheres, fresh and salt water, weak alkalis and acids.
Bronze, Phosphor, 5%	Generally available.*	95 Cu; 5 Sn; P	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, Fourdrinier wire, organic and weak mineral acids.
Bronze, Silicon, High	Bridgeport Brass Co., Bridgeport, Conn.	97 Cu; 3 Si	Water, non-oxidizing acids, refrigerants, atmosphere.
Bronze, Silicon, Low	Bridgeport Brass Co., Bridgeport, Conn.	98.1 Cu; 1.9 Si	Water, non-oxidizing acids, refrigerants, atmosphere.
Bronze, Spring	Scovill Mfg. Co., Waterbury, Conn.	86.5 Cu; 2 Sn; 11.5 Zn	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, organic and weak mineral acids.
Bronze, Telnic	Chase Brass & Copper Co., Waterbury, Conn.	98.25 Cu; 1 Ni; 0.5 Te; 0.25 P	Corrosive atmospheres, fresh and salt water, weak alkalis and acids.
Bronze, Tobin	Generally available.*	60 Cu; 39.25 Zn; 0.75 Sn	Salt water, atmosphere.
Bronze 444	Chase Brass & Copper Co., Waterbury, Conn.	88 Cu; 4 Pb; 4 Sn; 4 Zn	Corrosive atmospheres, fresh and salt water, weak alkalis and acids.
Buflokast Gray Iron	Buflovak Equipment Div., Blaw-Knox Co.	Fe; 3–4 C; 2 max. Ni; 1–2 Si; 0.5–1.25 Mn; 0.12 max. S; 0.3 max. P	Caustic soda, caustic potash, dyes, sulphite liquors.

Calite A	Calorizing Co., Wilkinsburg, Pa.	Fe; 35 Ni; 15 Cr	
Calite B28	Calorizing Co., Wilkinsburg, Pa.	Fe; 25 Cr; 10 Ni; 1 Mo	
Carpenter Stainless No. 7-Mo	Carpenter Steel Co., Reading, Pa.	27.0 Cr; 5.0 Ni; 2.0 Mo; 0.2 max. C; bal. Fe	For improved resistance to stress corrosion cracking.
Carpenter Stainless 20	Carpenter Steel Co., Reading, Pa.	Fe; 29 Ni; 20 Cr; 3 Cu; 2 Mo; 0.07 max. C	Sulphuric, mixed, phosphoric, oxalic, fatty acids.
Causul Metal	Lunkenheimer Co., Cincinnati, Ohio	Fe; 19 Ni; 2.2-2.8 C; 4 Cu; 1.5 Cr	Sulphuric acid; sodium hydroxide; brine; paper liquors (sulphate and soda processes).
Chemalloy A52N	Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio	Fe; 21 Cr; 27 Ni; 2 Mo; 3 Cu; 2 Si	Non-oxidizing media.
Chemalloy H1	Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio	Ni; 21 Mo; 21 Fe	Halogen ion services.
Chemalloy H2	Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio	Ni; 29 Mo; 6 Fe	Hydrochloric, phosphoric, sulphuric acids.
Chemalloy H3	Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio	Ni; 14 Cr; 16 Mo; 4 W; 6 Fe	Strong oxidizing agents, sulphurous, acetic, formic acids.
Chemalloy H4	Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio	Ni; 10 Si; 3 Cu	Sulphuric acid.
Chlorimet 2	Duriron Co., Dayton, Ohio	63 Ni; 32 Mo; 3 Fe; 0.10 C; 1 Si	Hydrochloric, sulphuric, phosphoric acids, non-oxidizing chlorides.
Chlorimet 3	Duriron Co., Dayton, Ohio	60 Ni; 18 Mo; 18 Cr; 3 Fe; 0.07 max. C; 1 Si	Hydrochloric, sulphuric, phosphoric, chloroacetic acids; moist chlorine.
Chromax	Driver-Harris Co., Harrison, N. J.	Fe; 19 Cr; 35 Ni	Cyanide pots; neutral and alkaline salts; mild hydrochloric, sulphuric, organic acids.
Chromel A	Hoskins Mfg. Co., Detroit, Mich.	80 Ni; 20 Cr	
Chromel C and D	Hoskins Mfg. Co., Detroit, Mich.	35-61 Ni; 16-18½ Cr; 23-46½ Fe	
Chromel P	Hoskins Mfg. Co., Detroit, Mich.	90 Ni; 10 Cr	
Colmonoy	Wall-Colmonoy Corp., Detroit, Mich.	Ni-Cr-B hard-facing alloys	Valve and pump parts in sulphuric and hydrochloric acid, sodium and potassium hydroxide, brine, and sulphurous acid services.
Colonial 610	Vanadium Alloys Steel Co., Latrobe, Pa.	Fe; 16-18 Cr; 1 Ni; 0.12 max. C; S (optional)	
Cooper FA20	Cooper Alloy Foundry Co., Hillside, N. J.	0.07 max. C; 20 Cr; 29 Ni; 1 Si; 3.5 Mo; 4 Cu	Sulphuric, hydrochloric, phosphoric acids; oxidizing chloride salts.
Copel	Hoskins Mfg. Co., Detroit, Mich.	55 Cu; 45 Ni	
Copper	Generally available.*	99.9 + Cu	Fresh and salt water, refrigerants (except ammonia), paper mill stock and white water, soil, brewery and distillery products.
Copper-Clad Steel (Phosphorus Deoxidized Copper)	Lukens Steel Co., Coatesville, Pa	Same as solid copper (in cladding)	Water, brewery and paper mill liquors, steam refrigerants, gasoline, oil, acetic acid.
Copper-Clad Steel (High Conductivity, Oxygen-Free Copper)	Lukens Steel Co., Coatesville, Pa.	Same as solid copper (in cladding)	
Copper-Arsenical	Bridgeport Brass Co., Bridgeport, Conn.	99.4 + Cu; 0.3 As; 0.02 P	Fresh and salt water, refrigerants (except ammonia), paper mill stock and white water, soil, brewery and distillery products.
Copper, Beryllium	Generally available.*	97.5 Cu; 2.15 Be; 0.35 Ni	
Copper, Cadmium	Phelps Dodge Copper Prod. Corp., New York, N. Y.	99 Cu; 1 Cd	
Copper, Cadmium	Bridgeport Brass Co., Bridgeport, Conn.	99.0 Cu; 1.0 Cd	
Copper, Deoxidized	Generally available.*	99.9 + Cu; 0.01-0.03 P	Water, distillery, brewery and paper mill liquors, steam refrigerants, gasoline, oil, salts, acetic acid.
Copper, Tellurium	Chase Brass & Copper Co., Waterbury, Conn.	99.5 Cu; 0.5 Te	Corrosive atmospheres, fresh and salt water, weak alkalis and acids.
Corrosiron	Pacific Fdry Co., San Francisco, Calif.	Fe; 14.5 Si	Nitric, sulphuric, chromic, hydrochloric acids; mine water; ferrous and copper sulphate.
Croloy Intermediate	Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa.	Fe; 5, 7 or 9 Cr; 0.5 or 1 Mo	Petrol. ref. (sulphur compounds).
Croloy Clad Plate	Babcock & Wilcox Co., Process Equipment Dept., Barberton, Ohio	Steel clad with various standard stainless steels	
Cupaloy	Westinghouse Electric Corp., Pittsburgh, Pa.	99.4 Cu; 0.1 Ag; 0.5 Cr	Oxidation resistance at high temperatures.
Cuprou	Wilbur B. Driver Co., Newark, N. J.	Cu; 45 Ni	
Cupro-Nickel, 10, 15, 20, 30%	Generally available.*	Cu; 10, 15, 20 or 30 Ni	Sea and harbor waters, salt brines, non-oxidizing acids.
Discaloy	Westinghouse Electric Corp., Pittsburgh, Pa.	25 Ni; 13 Cr; 3 Mo; 1.6 Ti; bal. Fe	Oxidation resistance at high temperature.
Dopploy 30	Sowers Mfg. Co., Buffalo, N. Y.	Fe; 18.5 Ni; 2.35 Cr; 2.85 C; 1 Mn	
Dowmetal	Dow Chemical Co., Midland, Mich.	Various magnesium alloys	Hydrofluoric acid, strong caustic and alkalis, chromic acid.
Duranickel	International Nickel Co., New York, N. Y.	93.7 Ni; 4.4 Al; 0.17 C	Same as nickel.
Durco D-10	Duriron Co., Dayton, Ohio	65 Ni; 23 Cr; 3.5 Cu; 2 Mo; 1 Mn; 5 Fe	Sulphuric, phosphoric acids.
Durichlor	Duriron Co., Dayton, Ohio	Fe; 0.85 C; 14.5 Si; 3 Mo; 0.65 Mn	Hydrochloric acid, hypochlorite bleaches, chloride solutions, moist chlorine.
Durimet 20	Duriron Co., Dayton, Ohio	Fe; 20 Cr; 29 Ni; 0.07 max. C; 2 Mo; 4 Cu; 1 Si	Sulphuric, nitric, acetic, sulphurous acids; fatty acids; plating solutions.
Duriron	Duriron Co., Dayton, Ohio	Fe; 0.85 C; 14.5 Si; 0.65 Mn	Sulphuric, nitric, acetic acids; alum solutions; plating solutions.
Everdur 1000	Amer. Brass Co., Waterbury, Conn.	94.9 Cu; 4 Si; 1.1 Mn	
Everdur 1010	Amer. Brass Co., Waterbury, Conn.	95.8 Cu; 3.1 Si; 1.1 Mn	
Everdur 1015	Amer. Brass Co., Waterbury, Conn.	98.25 Cu; 1.5 Si; 0.25 Mn	
Fanweld	Fansteel Metallurgical Corp., North Chicago, Ill.	Hard facing rod; W, Cr, Co, TaC, CbC	Nitric, sulphuric, acetic, lactic acids; salt water brine; hydrogen sulphide.
Frontier 5	Frontier Bronze Corp., Niagara Falls, N. Y.	89 Cu; 10 Al; 1 Fe	Organic acid stills.
Frontier 11	Frontier Bronze Corp., Niagara Falls, N. Y.	88 Cu; 5 Ni; 5 Sn; 2 Zn	
Frontier 40E	Frontier Bronze Corp., Niagara Falls, N. Y.	5.5 Zn; 0.5 Mg; 0.5 Cr; 0.2 Ti	Salt water.
Gold	Baker & Co. Inc., Newark, N. J.	99.99 Au	Nitric, hydrochloric, sulphuric, hydrofluoric acids.
Gold	American Platinum Works, Newark, N. J.		
Gold	Handy and Harman, New York, N. Y.	99.99 Au	
Gun Metal	Mueller Brass Co., Port Huron, Mich.		
Hastelloy B	Haynes Stellite Co., A Division of Union Carbide & Carbon Corp., Kokomo, Ind.	Ni; 26-30 Mo; 4-7 Fe	Hydrochloric, sulphuric, phosphoric, nitric, acetic, formic acids.
Hastelloy C	Haynes Stellite Co., A Division of Union Carbide & Carbon Corp., Kokomo, Ind.	Ni; 16-18 Mo; 4-7 Fe; 14-16 Cr; 3.75-5 W	Strong oxidizing agents, free chlorine; phosphoric, nitric, sulphuric acids.

Materials	Manufacturer	Description	Most Important Applications
Hastelloy D	Haynes Stellite Co., A Division of Union Carbide & Carbon Corp., Kokomo, Ind.	Ni; 8–11 Si; 3–5 Cu	Sulphuric, acetic, formic, phosphoric acids.
Haynes Stellite 1	Haynes Stellite Co., A Division of Union Carbide & Carbon Corp., Kokomo, Ind.	Co; 30–32 Cr; 12–14 W	Chlorine; sulphuric, nitric acids.
Haynes Stellite 6	Haynes Stellite Co., A Division of Union Carbide & Carbon Corp., Kokomo, Ind.	Co; 27–29 Cr; 3.75–4.5 W	Sulphuric, nitric acids.
Haynes Stellite 12	Haynes Stellite Co., A Division of Union Carbide & Carbon Corp., Kokomo, Ind.	Co; 28–30 Cr; 7.5–9 W	Sulphuric, nitric acids.
Haynes Stellite 98M2	Haynes Stellite Co., A Division of Union Carbide & Carbon Corp., Kokomo, Ind.	Co; 30–31 Cr; 18.55–18.95 W; 3.5–3.75 Ni	Sulphuric acid.
Haynes Stellite Star J	Haynes Stellite Co., A Division of Union Carbide & Carbon Corp., Kokomo, Ind.	Co; 32–32.75 Cr; 17.25–17.75 W	Sulphuric acid.
Herculoy	Revere Copper & Brass, New York, N. Y.	96–98 Cu; 1.5–3 Si; 0.25–1 Mn	Atmosphere, fresh and salt water, brewery and distillery products.
Hytensl	Amer. Manganese Bronze Co., Philadelphia, Pa.	60–68 Cu; 20–24 Zn; 3–7 Al; 2.5–5 Mn; 2–4 Fe	
Illium G	The Illium Corp., Freeport, Ill.	56 Ni; 22.5 Cr; 6.5 Mo; 6.5 Fe; 6.5 Cu; Mn; Si; C	Sulphuric, nitric, phosphoric, mixed acids; various acid-salt solutions.
Illium R (wrought)	The Illium Corp., Freeport, Ill.	64 Ni; 22 Cr; 5 Mo; 2.5 Fe; 6 Cu; Mn; Si; C	Sulphuric, nitric, phosphoric, mixed acids; various acid-salt solutions.
Incoloy	International Nickel Co., New York, N. Y.	Fe; 32–36 Ni; 19–22 Cr; 0.10 max. C	High temperature oxidation resistance.
Inconel	International Nickel Co., New York, N. Y.	76 Ni; 15.5 Cr; 7.5 Fe; 0.08 C	Organic acids, pharmaceuticals, alcoholic beverages, food, alkali fusion.
Inconel X	International Nickel Co., New York, N. Y.	73 Ni; 15 Cr; 7 Fe; 1 Cb; 2.5 Ti; 0.04 C	High temperature oxidation resistance.
Inconel-Clad Steel	Lukens Steel Co., Coatesville, Pa.		Carbonic, lactic, picric acids; cola syrup; penicillin; wine.
Indium	Amer. Smelting and Ref. Co., New York, N. Y.	In.	
Indium	Indium Corp. of America, New York, N. Y.	In.	
Isocast 20	Empire Steel Castings, Inc., Reading, Pa.	Fe; 20 Cr; 29 Ni; 0.07 max. C; 3.5 min. Cu; 1.75 Mo; 1 min. Si	
K42B	Westinghouse Electric Corp., Pittsburgh, Pa.	42 Ni; 22 Co; 18 Cr; 15.9 Fe; 2.1 Ti	Oxidation resistance at high temperatures.
Lead	Eagle-Pitcher Co., Cincinnati, Ohio	99.9 + Pb	Sulphuric, sulphurous, phosphoric, chromic acids.
Lead	St. Joseph Lead Co., New York, N. Y.	99.9 + Pb	
Lead	National Lead Co., New York, N. Y.	99.9 + Pb	
Lead, Antimonial	Amer. Smelting & Ref. Co., New York, N. Y.	94 Pb; 6 Sb	Sulphuric, sulphurous, phosphoric, chromic acids.
Lead, Antimonial	Eagle-Pitcher Co., Cincinnati, Ohio		Sulphuric, sulphurous, phosphoric, chromic acids.
Lead, Antimonial	National Lead Co., New York, N. Y.	Pb; 6 Sb	Sulphurous, sulphuric, phosphoric, chromic acids; hydroxides; chlorides.
Lead, Antimonial	Northwest Lead Co., Seattle, Wash.	93.45 Pb; 6.5 Sb; 0.04–0.08 Cu	Sulphuric, phosphoric acids; aluminum sulphate; sodium sulphate; ammonium sulphate; mixed acids.
Lead, Chemical	Eagle-Pitcher Co., Cincinnati, Ohio		Sulphuric, sulphurous, phosphoric, chromic acids.
Lead, Chemical	National Lead Co., New York, N. Y.	99.93 Pb; 0.06 Cu; 0.01 Ag; 0.005 Bi	Sulphurous, sulphuric, phosphoric, chromic acids; hydroxides; chlorides.
Lead, Chemical	Northwest Lead Co., Seattle, Wash.	99.95 Pb; 0.04–0.08 Cu	Sulphuric, phosphoric acids; aluminum sulphate; sodium sulphate; ammonium sulphate; mixed acids.
Lead, Tellurium	Northwest Lead Co., Seattle, Wash.	99.9 Pb; 0.02–0.06 Te; 0.04–0.08 Cu	Sulphuric, phosphoric acids; aluminum sulphate; sodium sulphate; ammonium sulphate; mixed acids.
Lead, Tellurium	Eagle-Pitcher Co., Cincinnati, Ohio		Sulphuric, sulphurous, phosphoric, chromic acids.
Lead, Tellurium	National Lead Co., New York, N. Y.	99.88 Pb; 0.04 Te; 0.06 Cu	Sulphurous, sulphuric, phosphoric, chromic acids; hydroxides, chlorides.
Lukens Clad Steel Plate	Lukens Steel Co., Coatesville, Pa.	Steel plate with Inconel, Monel, nickel, stainless, or copper	Corrosion resistance same as the solid metals.
Misco 20	Michigan Steel Casting Co., Detroit, Mich.	Fe; 30 Ni; 20 Cr; 2.5 Mo; 4 Cu	
Monel	International Nickel Co., New York, N. Y.	67 Ni; 30 Cu; 1.4 Fe; 0.15 C	Non-oxidizing mineral acids, fixed alkalis, brines and sea water, fatty acids, organic solvents.
Monel	C. O. Jelliff Mfg. Co., Southport, Conn.	67 Ni; 30 Cu; 1.4 Fe; 0.15 C	Non-oxidizing mineral acids, fixed alkalis, brines and sea water, fatty acids, organic solvents.
Monel	Cooper Alloy Foundry Co., Hillside, N. J.	67 Ni; 30 Cu; 1.4 Fe; 0.15 C	Non-oxidizing mineral acids, fixed alkalis, brines and sea water, fatty acids, organic solvents.
Monel K	International Nickel Co., New York, N. Y.	66 Ni; 29 Cu; 0.9 Fe; 2.75 Al; 0.15 C	Non-oxidizing mineral acids, fixed alkalis, brines and sea water, fatty acids, organic solvents.
Monel-Clad	Lukens Steel Co., Coatesville, Pa.		Acetic, hydrofluoric, oxalic acids, alcohol, butadiene, carbon dioxide.
Muntz Metal	Generally available.*	60 Cu; 40 Zn	
N-3 Metal	Lukenheimer Co., Cincinnati, Ohio	Cu; 32 Ni; 2.75 Pb; 0.50 Si; 0.75 Mn	Sludge acid, sulphuric, sea water, alum. salt solutions, garbage liquor.
National A1 Alloys	National Smelting Co., Cleveland, Ohio	Al; 0–4 Cu; 0–4 Mg; 0–7.5 Si; 0–0.6 Mn; 0–1.5 Ni	
Niag (Nickel Silver)	Mueller Brass Co., Port Huron, Mich.	46 Cu; 10 Ni; 2 Pb; Zn	
Nichrome	Driver-Harris Co., Harrison, N. J.	60 Ni; 15 Cr; Fe	Cyanide pots; neutral and alkaline salts; mild hydrochloric, sulphuric, organic acids.
Nichrome V	Driver-Harris Co., Harrison, N. J.	80 Ni; 20 Cr	Neutral and alkaline salts; mild hydrochloric, sulphuric, organic acids.
Nickel	International Nickel Co., New York, N. Y.	99.4 Ni; 0.05 C	Fixed alkalis, hydrochloric acid, food, phenol, organic solvents, rayon spin solutions.
Nickel L	International Nickel Co., New York, N. Y.	99.4 Ni; 0.01 C	Fused alkalis.
Nickel-Clad	Lukens Steel Co., Coatesville, Pa.		Caustic soda, fatty acids, naphtha, crude phenol, petroleum, pulp and paper, soap.
Nickel, Rhodium	J. Bishop & Co., Malvern, Pa.	Ni; 37 Rh	Corrosive and oxidizing atmospheres; sulphuric, nitric, hydrochloric, and hydrofluoric acids; halogens.
Nickel Silver, 5, 10, 12, 18%	Generally available.*	65 Cu; 5, 10, 12, or 18 Ni; bal. Zn	Corrosive atmospheres, hot and cold fresh water, salt water, weak alkalis, organic and weak mineral acids.

Nicloy	Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa.	Fe; 3.5, 5 or 9 Ni	Alkaline solutions, mild organic acids.
Ni-Hard	International Nickel Co., New York, N. Y.	Fe; 3.4 C; 1.5 Cr; 4.5 Ni; 0.6 Si	
Nilstain	Wilbur B. Driver Co., Newark, N. J.	Fe; 18–20 Cr; 8–10 Ni; 0.2 max. C; 2 max. Mn	
Ni-Resist	International Nickel Co., New York, N. Y.	Fe; 2.8 C; 14 or 20 Ni; 6 Cu (optional); 2 Cr; 2 Si	
Nirex	Driver-Harris Co., Harrison, N. J.	80 Ni; 14 Cr; 6 Fe	Neutral and alkaline salts; mild hydrochloric, sulphuric, organic acids.
NS-5 Metal	Lunkenheimer Co., Cincinnati, Ohio	50 Ni; 46 Cu; 2.2 Si; 1.9 Mn	Corrosion resistance similar to Monel.
Olympic Bronze, Type A	Chase Brass & Copper Co., Waterbury, Conn.	96 Cu; 3 Si; 1 Zn	Pickling acids and salt brines.
Palladium	J. Bishop & Co., Malvern, Pa.	99.95 Pd	
Palladium	Baker & Co., Newark, N. J.	99.99 Pd	Hydrochloric, sulphuric, hydrofluoric acids.
Palladium	American Platinum Works, Newark, N. J.		
Pennalloy	Pennsylvania Elec. Steel Casting Co., Hamburg, Pa.		
Permite Al Alloys	Aluminum Industries, Cincinnati, Ohio	Al; 0–5 Cu; 1.5–7.5 Si; 0–1 Fe; 0–0.4 Mg	
Pioneer 14	Pioneer Alloy Products Co., Cleveland, Ohio	35 Ni; 25 Cr; 5 Mo; 4 Cu	Sulphuric and nitric acids at elevated temperatures.
Pioneer 16	Pioneer Alloy Products Co., Cleveland, Ohio	70 Ni; 26 Mo; 4 Cu	Hydrochloric and sulphuric acids, all concentrations and high temp.
Platinum	Baker & Co., Newark, N. J.	99.99 Pt	Nitric, hydrochloric, sulphuric, hydrofluoric acids; chlorine, bromine.
Platinum	J. Bishop & Co., Malvern, Pa.	99.95 Pt	Corrosive and oxidizing atmospheres; sulphuric, nitric, hydrofluoric and hydrochloric acids.
Platinum	American Platinum Works, Newark, N. J.		
Platinum, Iridium	American Platinum Works, Newark, N. J.	Pt; 5–30 Ir	Nitric, hydrochloric, sulphuric, hydrofluoric acids; chlorine, bromine.
Platinum, Iridium	Baker & Co., Newark, N. J.	Pt; 5–30 Ir	Nitric, hydrochloric, sulphuric, hydrofluoric acids; chlorine; bromine.
Platinum, Iridium	J. Bishop & Co., Malvern, Pa.	Pt; 1–10 Ir	Corrosive and oxidizing atmospheres; sulphuric, nitric, hydrofluoric, and hydrochloric acids.
Platinum, Rhodium	American Platinum Works, Newark, N. J.	Pt; 5–40 Rh	Nitric, hydrochloric, sulphuric, hydrofluoric acids; chlorine, bromine.
Platinum, Rhodium	Baker & Co., Newark, N. J.	Pt; 5–40 Rh	Nitric, hydrochloric, sulphuric, hydrofluoric acids; chlorine, bromine.
Platinum, Rhodium	J. Bishop & Co., Malvern, Pa.	Pt; 5–10 Rh	Corrosive and oxidizing atmospheres; sulphuric, nitric, hydrochloric, and hydrofluoric acids; halogens.
Pyrasteel	Chicago Steel Fdry. Co., Chicago, Ill.	Fe; 25–27 Cr; 12–14 Ni; 0.1–0.35 C; Mo, Cb, Se (optional)	
Pyrocast	Pacific Fdry. Co. Ltd., San Francisco, Calif.	Fe; 25 Cr	Hot sulphur dioxide atmospheres, cyanide pots, mercuric nitrate.
Refractaloy-26	Westinghouse Electric Corp., Pittsburgh, Pa.	37 Ni; 20 Co; 18 Cr; 3 Mo; 2.9 Ti; 18.1 Fe; 1 Si	Oxidation resistance at high temperatures.
Refractaloy-70	Westinghouse Electric Corp., Pittsburgh, Pa.	20 Ni; 30 Co; 20 Cr; 13 Fe; 8 Mo; 9 W	Oxidation resistance at high temperatures.
Relleum Brass Forging	Mueller Brass Co., Port Huron, Mich.	59 Cu; 2 Pb; 39 Zn	
Resistac	Amer. Manganese Bronze Co., Philadelphia, Pa.	90 Cu; 10 Al	Sulphuric acid, salt solutions and vapors
Revalon	Revere Copper and Brass, New York, N. Y.	76 Cu; 22 Zn; 2 Al	Salt and fresh water.
Rex Z-Metal	Chain Belt Co., Milwaukee, Wis.	Iron carbide particles in ferrite matrix	Sugar cane solution, salt and mine water, sulphuric, tannic and actic acids.
Roofloy	Amer. Smelting & Ref. Co., New York, N. Y.	Pb; 0.25 Sn; 0.02 Mg; 0.02 Bi	
Silver	Baker & Co. Inc., Newark, N. J.	99.9 plus Ag	Sulphuric, hydrofluoric, acetic acids.
Silver	Handy & Harman, New York, N. Y.	99.9 plus Ag	
Silver	American Platinum Works, Newark, N. J.		
Stainless 20-Clad Steel	Lukens Steel Co., Coatesville, Pa.	Cladding: 20 Cr; 29 Ni; 3 Cu min.; 2 Mo min.; 1 Si; 0.75 Mn; 0.07 C max.	Sulphuric acid; nitric-sulphuric mixtures; pickling solutions; benzoic acid, arsenic; citric and fatty acids.
Stainless-Clad 302	Jessop Steel Co., Washington, Pa.		
Stainless-Clad 304	Lukens Steel Co., Coatesville, Pa., Jessop Steel Co., Washington, Pa.		
Stainless-Clad 316	Lukens Steel Co., Coatesville, Pa., Jessop Steel Co., Washington, Pa.		
Stainless-Clad 347	Lukens Steel Co., Coatesville, Pa., Jessop Steel Co., Washington, Pa.		
Stainless-Clad 405	Jessop Steel Co., Washington, Pa.		
Stainless-Clad 410	Lukens Steel Co., Coatesville, Pa., Jessop Steel Co., Washington, Pa.		
Stainless-Clad 430	Lukens Steel Co., Coatesville, Pa., Jessop Steel Co., Washington, Pa.		
Stainless Type 301		Fe; 16–18 Cr; 6–8 Ni; 0.08–0.15 C	Automotive and decorative trim, high tensile cold rolled strip.
Stainless Type 302		Fe; 17–19 Cr; 8–10 Ni; 0.08–0.15 C	Milk, carbonated water, fruit juices, room temp. basic salts, atmosphere.
Stainless Type 302B		Fe; 17–19 Cr; 8–10 Ni; 0.08–0.15 C; 2–3 Si	
Stainless Type 303		Fe; 17–19 Cr; 8–10 Ni; 0.15 max. C; 0.07 min. P, S, Se; 0.6 max. Zr; Mo; 2 max. Mn	Free machining, slightly less corrosion resistant than 302.
Stainless Type 304		Fe; 18–20 Cr; 8–11 Ni; 0.08 max. C; 2 max. Mn	Basic salts; nitric, acetic, fatty acids; sour crudes.
Stainless Type 308		Fe; 19–21 Cr; 10–12 Ni; 0.08 max. C	Sulphite liquors; basic salts; nitrates; nitric, acetic acid.
Stainless Type 309		Fe; 22–24 Cr; 12–15 Ni; 0.2 max. C	Hot oxidizing gases, nitric acid, sour crudes.
Stainless Type 310		Fe; 24–26 Cr; 19–22 Ni; 0.25 max. C	Hot oxidizing gases; sulphur dioxide; nitric, fatty, acetic acids; sour crudes.
Stainless Type 316		Fe; 16–18 Cr; 10–14 Ni; 0.1 max. C; 1.75–2.75 Mo	Hot acetic and fatty acids, sulphite liquor, sulphur dioxide, phosphoric acid, phthalic anhydride, photo emulsions.
Stainless Type 317		Fe; 17.5–20 Cr; 10–14 Ni; 0.1 max. C; 3–4 Mo	Slightly better than 316 because of higher Mo.
Stainless Type 321		Fe; 17–19 Cr; 8–11 Ni; Ti, 5x C min.	High temperature applications.

NOTE: *Listed below are the producers of standard stainless steels for which type analyses have been established by the Amer. Iron and Steel Inst.*

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Alloy Metal Wire Co., Prospect Park, Pa.
Amer. Chain & Cable Co., Bridgeport, Conn.
Armco Steel Corp., Middletown, Ohio
Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
A. M. Byers Co., Pittsburgh, Pa.
Carpenter Steel Co., Reading, Pa.

Materials	Manufacturer	Description	Most Important Applications
Stainless Type 347	Crucible Steel Co. of America, New York, N. Y. Wilbur B. Driver Co., Newark, N. J. Driver-Harris Co., Harrison, N. J. Eastern Stainless Steel Corp., Baltimore, Md. Firth Sterling Steel Co., McKeesport, Pa. Globe Steel Tubes Co., Milwaukee, Wis. Henry Disston & Sons, Philadelphia, Pa. Ingersoll Steel Div., Borg-Warner Corp., New Castle, Ind. Jessop Steel Co., Washington, Pa. Joslyn Mfg. & Supply Co., Chicago, Ill. Latrobe Electric Steel Co., Latrobe, Pa. McLouth Steel Corp., Detroit, Mich. Midvale Co., Philadelphia, Pa. Pittsburgh Steel Co., Pittsburgh, Pa. Trent Tube Mfg. Co., Div. of Crucible Steel Co. of America, East Troy, Wis. United States Steel Co., Pittsburgh, Pa. Universal Cyclops Steel Corp., Bridgeville, Pa. Vanadium Alloys Steel Co., Latrobe, Pa. Wallingford Steel Co., Wallingford, Conn.	Fe; 17-19 Cr; 9-12 Ni; Cb, 10x C min.	Same as 304 but for stress relieving or welding of heavy sections.
Stainless Type 403		Fe; 11.5-13 Cr; 0.15 max. C; (turbine quality)	Steam turbine blades.
Stainless Type 405		Fe; 11.5-13.5 Cr; 0.08 max. C; 0.1-0.3 Al	Same as 410 but does not harden appreciably on cooling.
Stainless Type 406		Fe; 12-14 Cr; 0.15 max. C; 3.5-4.5 Al	
Stainless Type 410		Fe; 11.5-13.5 Cr; 0.15 max. C	Hardened valve and pump parts; ammonia, mild fatty, nitric, carbonic acids.
Stainless Type 414		Fe; 11.5-13.5 Cr; 1.25-2.5 Ni; 0.15 max. C	Same as 410 but more responsive to heat treatment.
Stainless Type 416		Fe; 12-14 Cr; 0.15 max. C; 0.07 min. P, S, Se; 0.6 max. Zr, Mo	Free machining, slightly less resistant than 410.
Stainless Type 418		Fe; 12-14 Cr; 0.15 max. C; 2.5-3.5 W	Intermediate high temperature service.
Stainless Type 420		Fe; 12-14 Cr; 0.15 min. C	Cutlery and dental tools.
Stainless Type 430		Fe; 14-18 Cr; 0.12 max. C	Automotive and decorative trim, nitric acid, hot oxidizing gases.
Stainless Type 430F		Fe; 14-18 Cr; 0.12 max. C; 0.07 min. P, S, Se; 0.6 max. Zr, Mo	Free machining, slightly less resistant than 430.
Stainless Type 431		Fe; 15-17 Cr; 1.25-2.5 Ni; 0.2 max. C	Hardenable, resistance approaches 302, paper mill beater bars, Jordan bars.
Stainless Type 440A		Fe; 16-18 Cr; 0.6-0.75 C; 0.75 max. Mo	About same as 410.
Stainless Type 440B		Fe; 16-18 Cr; 0.75-0.95 C; 0.75 max. Mo	About same as 410.
Stainless Type 440C		Fe; 16-18 Cr; 0.95-1.2 C; 0.75 max. Mo	About same as 410.
Stainless Type 442		Fe; 18-23 Cr; 0.25 max. C	High temperatures; nitric, fatty, citric acids; plastic molds, acetic anhydride.
Stainless Type 443		Fe; 18-23 Cr; 0.2 max. C; 0.9-1.25 Cu	
Stainless Type 446		Fe; 23-27 Cr; 0.35 max. C; 0.25 max. N	High temperatures; nitric, citric, lactic acids; acetic anhydride; ammonium phosphate.
Stainless Type 501		Fe; 4-6 Cr; 0.1 min. C	High temperature oxidation resistance (petrol. refining).
Stainless Type 502		Fe; 4-6 Cr; 0.1 max. C	Same as 501.
Still Metal	Amer. Manganese Bronze Co., Philadelphia, Pa.		
Stoody 1	Stoody Co., Whittier, Calif.	Non-ferrous; Co, Cr, W welding rod	Severe abrasion and heat with sulphuric, nitric, acetic acids; chlorides.
Stoody 6	Stoody Co., Whittier, Calif.	Non-ferrous; Co, Cr, W welding rod	Abrasion, heat, impact with sulphuric, nitric, acetic acids; chlorides.
Super Nickel	Amer. Brass Co., Waterbury, Conn.	69.6 Cu; 30 Ni; 0.4 Fe	
Tantalum	Fansteel Metallurgical Corp., North Chicago, Ill.	99.9 + Ta	Hydrochloric, nitric, sulphuric, hydrobromic acids; hydrogen peroxide; ferric chloride.
Ternalloy	Apex Smelting Co., Chicago, Ill.	Al; 2.7-5.0 Zn; 1.4-2.6 Mg; 0.5 Mn	Atmosphere; water; most neutral aqueous solutions; most organic compounds not producing halides; foods.
Tisco 150 Alloy	Taylor-Wharton Iron and Steel Co., High Bridge, N. J.	High chromium cast iron	
Tisco Timang Mn Ni Steel	Taylor-Wharton Iron and Steel Co., High Bridge, N. J.	13 Mn; 3 Ni	
Tisco Mn Steel	Taylor-Wharton Iron and Steel Co., High Bridge, N. J.	Fe; 12 Mn (Hadfield type)	
Titanium Ti 75A	Titanium Metals Corp. of America, New York, N. Y.	Commercially pure; 99.4 Ti	All chloride salts (sea water, etc.), fuming nitric acid, all alkali salts and bases, wet chlorine. Corrosion resistances of commercially pure titanium and alloy grades are identical. In general titanium exceeds 18-8 stainless in all corrosive conditions, and has additional resistance to many corrosives which attack 18-8.
Titanium Ti-100A	Titanium Metals Corp. of America, New York, N. Y.	Commercially pure; 99.3 Ti	
Titanium Ti-150A	Titanium Metals Corp. of America, New York, N. Y.	2.0 Fe; 2.0 Cr; 2.0 Mo; 93.7 Ti	
Toncam Cu Mo Iron	Republic Steel Corp., Cleveland, Ohio		
Tophet A	Wilbur B. Driver Co., Newark, N. J.	80 Ni; 20 Cr	
Tophet C	Wilbur B. Driver Co., Newark, N. J.	Fe; 60 Ni; 15 Cr	
Tophet D	Wilbur B. Driver Co., Newark, N. J.	Fe; 35 Ni; 18.5 Cr	
Tri-Clover	Tri-Clover Machine Co., Kenosha, Wis.	Various standard stainless steel fittings	
Tube Borium	Stoody Co., Whittier, Calif.		
Tuf-Stuf E	Mueller Brass Co., Port Huron, Mich.	89 Cu; 10 Al; 1 Fe	
Tuf-Stuf C	Mueller Brass Co., Port Huron, Mich.	87 Cu; 10 Al; 3 Fe	
Tuf-Stuf H	Mueller Brass Co., Port Huron, Mich.	86 Cu; 11 Al; 3 Fe	
Tuf-Stuf K	Mueller Brass Co., Port Huron, Mich.	80 Cu; 10 Al; 2.5 Fe; 1 Mn; 5 Ni	
Corrosion-resistant grades			
Type CA-15	NOTE: *Listed below are the producers of standard cast heat and corrosion-resistant high alloys for which type analyses have been established by the Alloy Casting Institute.* Allegheny Ludlum Steel Corp., Pittsburgh, Pa. Alloy Steel Products Co., Linden, N. J. Amer. Cast Iron Pipe Co., Birmingham, Ala. American Steel Foundries Co., Newark, N. J. Atlas Fdry. Co., Irvington, N. J. Babcok & Wilcox Co., Boiler Div., Process Equipment Dept., Barberton, Ohio Calorizing Co., Wilkinsburg, Pa. Chicago Steel Fdry., Chicago, Ill. Cooper Alloy Fdry Co., Hillside, N. J. Crane Co., Chicago, Ill. Donegal Mfg. Corp., Marietta, Pa. Driver Harris Co., Harrison, N. J. Duraloy Co., Inc., Scottdale, Pa. Duriron Co., Inc., Dayton, Ohio	Fe; 11-14 Cr; 1 max. Ni; 0.15 max. C	Alkaline liquors.
Type CA-40		Fe; 11-14 Cr; 1 max. Ni; 0.2-0.4 C	Alkaline liquors.
Type CB-30		Fe; 18-22 Cr; 2 max. Ni; 0.3 max. C	Alcohol, vinegar, fruit juices, oxidizing acids.
Type CC-50		Fe; 26-30 Cr; 4 max. Ni; 0.5 max. C	
Type CE-30		Fe; 26-30 Cr; 8-11 Ni; 0.3 max. C	Sulphuric liquors.
Type CF-8		Fe; 18-20 Cr; 8-10 Ni; 0.08 max. C	Oxidizing mineral acids, organic acids, salts.
Type CF-20		Fe; 18-20 Cr; 8-10 Ni; 0.2 max. C	Sodium hydroxide, alum, mine waters, sulphur dioxide, citric, lactic, acetic acids, brine.
Type CF-16F		Fe; 18-20 Cr; 8-10 Ni; 0.08 max. C; 0.2-0.35 Se	
Type CF-8C		Fe; 18-20 Cr; 8-10 Ni; 0.08 max. C; 8xC-1 Cb	Same as CF-8 but heat treatment after welding not required.
Type CF-8M		Fe; 18-20 Cr; 8-10 Ni; 0.08 max. C; 2.0-3.0 Mo	
Type CF-12M		Fe; 18-20 Cr; 8-10 Ni; 0.12 max. C; 2.0-3.0 Mo	Same as CF-8 but better resistance to pitting.
Type CK-20		Fe; 23-27 Cr; 19-22 Ni; 0.25 max. C	Marine service, not for reducing acids.
Type CN-7 M Cu		Fe; 18-22 Cr; 21-31 Ni; 0.07 max. C; may contain others	Reducing acids.

Type HC Type HD Type HE Type HF Type HH Type HI Type HK Type HL Type HT Type HU Type HW Type HX (Heat-resistant grades)	Electric Steel Fdry. Co., Portland, Ore. Electro-Alloys Div., Amer. Brake Shoe Co., Elyria, Ohio Empire Steel Castings, Inc., Reading, Pa. Fahralloy Co., Harvey, Ill. General Alloys Co., Boston, Mass. General Metals Corp., Oakland, Calif. Grede Foundries, Milwaukee, Wis. Hanford Fdy. Co., San Bernardino, Calif. Haynes Stellite Co., Kokomo, Ind. Jessop Steel Co., Washington, Pa. Key Co., East St. Louis, Ill. Lebanon Steel Fdry., Lebanon, Pa. Los Angeles Steel Fdy. Co., Los Angeles, Calif. Michiana Products Corp., Michigan City, Ind. Michigan Steel Casting Co., Detroit Mich. Midvale Co., Philadelphia, Pa. National Alloy Div., Blaw-Knox Co., Blawknox, Pa. Ohio Steel Fdry. Co., Springfield, Ohio Pacific Fdry. Co., Ltd., San Francisco, Calif. Shawinigan Chemicals, Ltd. Montreal Que. Sivyer Steel Casting Co., Milwaukee, Wis. Standard Alloy Co., Cleveland, Ohio Stainless Fdy. & Engrng. Co., Milwaukee, Wis. Texas Electric Steel Casting Co., Houston, Tex. Utility Electric Steel Fdry, Los Angeles, Calif. U. S. Pipe and Fdy. Co., Burlington, N. J. Wausheka Fdy. Co., Wausheka, Wis. Welland Electric Steel Fdy. Ltd., Welland, Ont.	Fe; 26-30 Cr; 4 max. Ni Fe; 26-30 Cr; 3-6 Ni Fe; 26-30 Cr; 8-11 Ni Fe; 18-23 Cr; 8-12 Ni Fe; 24-27 Cr; 11-14 Ni Fe; 26-30 Cr; 13-17 Ni Fe; 24-27 Cr; 18-22 Ni Fe; 28-32 Cr; 18-22 Ni Fe; 13-17 Cr; 33-37 Ni Fe; 17-21 Cr; 37-41 Ni Fe; 10-14 Cr; 58-62 Ni Fe; 15-19 Cr; 64-68 Ni	Hot gases. Higher strength than HC. Furnace parts. Furnace parts, oil stills, power boilers. Hot gases, furnace parts, tube supports. Magnesium retorts. Furnace parts, oxidizing, high sulphur gases. Furnace parts, oxidizing, high sulphur gases. Carburizing service, thermal shock. Carburizing service, thermal shock. Carburizing service, thermal shock. Carburizing service, thermal shock.
Utiloy 20	Utility Electric Steel Fdry., Los Angeles, Calif.	20 Cr; 29 Ni; 1.75 Mo; 0.07 max. C	Sulphuric acid, oxidizing and reducing solutions.
Utiloy 100	Utility Electric Steel Fdry., Los Angeles, Calif.	98 Ni; 1 Si; 0.25 C	Rayon mfg., caustics.
Utiloy H	Utility Electric Steel Fdry, Los Angeles, Calif.	22-26 Cr; 11-13 Ni; 0.3 C	Hot oxidizing gases, furnace parts, oil still tube supports, cement mill retaining rings.
Utiloy NH	Utility Electric Steel Fdry., Los Angeles, Calif.	14-17 Cr; 34-37 Ni; 0.2-0.6 C	Heat treating boxes, cyanide pots, enamel furnace parts.
Worthite	Worthington Corp., Harrison, N. J.	Fe; 20 Cr; 24 Ni; 0.07 max. C; 3.25 Si; 3 Mo; 1.75 Cu; 0.6 Mn	Sulphuric, nitric, phosphoric, acetic acids; sulphate and sulphite paper liquors; citrus juices.
Wrought Iron	A. M. Byers Co., Pittsburgh, Pa.	Fe; 0.03 max. C; 0.05 max. Mn; 0.10-0.12 P; 0.025 max. S; 0.10-0.15 Si; 2.5-3.0 slag	Water, steam and condensate, brines, soil, caustics, corrosive atmospheres.
Wyndaloy	Wyndale Mfg. Corp., Indianapolis, Ind.		

CEMENT

Acichlor	Pecora Paint Co., Philadelphia, Pa.	Firm putty.	Hydrochloric, oxalic, nitric acids; ammonia; ammonium chloride, caustic soda.
Acidol	The Sullivan Co., Memphis, Tenn.	Pouring cements.	
Acitite	Pecora Paint Co., Philadelphia, Pa.	Ready mixed cement; troweling.	Hydrochloric, acetic, sulphuric, nitric acids; ammonium chloride, benzol.
Allane	Atlas Mineral Products Co., Mertztown, Pa.	Room temperatures setting chemical resistant plastic cement.	Non-oxidizing acids, hydrofluoric acid, organic acids, alkalis, salts and organic solvents.
Alk-Li-Pruf	Electro Chemical Supply & Engineering Co., Emmaus, Pa.	Alkali-resistant, synthetic-type cement.	Alkalis; sulphuric, hydrofluoric, hydrochloric, most organic acids; most organic solvents.
Alkor	Atlas Mineral Products Co., Mertztown, Pa.	Furan derivative; carbon aggregate.	Sulphuric, hydrochloric, hydrofluoric, organic acids; corrosive salts; alkalis.
Atlastic 60	Atlas Mineral Products Co., Mertztown, Pa.	Hot melt hydrocarbon plastic cement.	Oxidizing acids, non-oxidizing acids, organic acids, alkalis, salts, alcohol.
Atlastic 77	Atlas Mineral Products Co., Mertztown, Pa.	Asphaltic filled cement.	
Asplit	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Self-hardening resin cement.	Acids except high oxidizing acids and hydrofluoric.
Basolit, Carbon	Nukem Products Corp., Buffalo, N. Y.	Carbon-sulphur cement.	Hydrofluoric, nitric acids.
Basolit, Standard	Nukem Products Corp., Buffalo, N. Y.	Sulphur silicate based cement.	Sulphuric, hydrochloric, other mineral acids except hydrofluoric.
Berkoleum	Atlas Mineral Products Co., Mertztown, Pa.	Slow-setting silicate cement.	Oxidizing acids, non-oxidizing acids, organic acids, salts, organic solvents.
Bric-Bond	Ceilcote Co., Cleveland, Ohio	Sulphur cement; silica aggregate.	Mineral acids, nitric to 30%, weak or cold alkalis and salts.
Bric-Bond (Carbon)	Ceilcote Co., Cleveland, Ohio	Sulphur cement; carbon aggregate.	Mineral acids, nitric to 30%, including hydrofluoric, weak or cold alkalis and salts.
Brimsto	Electro Chemical Supply & Engineering Co., Emmaus, Pa.	Thiokol-sulphur base cement; crushed silica aggregate.	All inorganic acids, except hydrofluoric, over 30% nitric, over 50% sulphuric acids.
Carbo-Fix Carbo-Flex Carbo-Insulate Carbo-Mold	Carboline Co., St. Louis, Mo.	(Carbon) Room temperatures, thermo-setting carbon cements.	Acetic, hydrochloric, sulphuric acids; benzol; chlorinated hydrocarbons; sodium hydroxide.
Carbo-Korez	Atlas Mineral Products Co., Mertztown, Pa.	Phenol-formaldehyde; carbon aggregate.	Sulphuric, hydrochloric, hydrofluoric, phosphoric, organic acids; corrosive salts.
Carbo Vitrobond	Atlas Mineral Products Co., Mertztown, Pa.	Sulphur-Thiokol cement.	Sulphuric, nitric, hydrochloric, hydrofluoric acids; corrosive salts.
Carbon-Brimsto	Electro Chemical Supply & Engineering Co., Emmaus, Pa.	Thiokol-sulphur base cement; carbon flour aggregate.	All inorganic acids, except hydrofluoric.
Carolina	Charlotte Chemical Laboratories, Charlotte, N. C.	Acidproof cement.	
Causplit	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Self-hardening resin cement.	Most acids and alkalis except high oxidizing acids.
Ceilcote Resin Cement	Ceilcote Co., Cleveland, Ohio	Furan resin cement with silica and carbon fillers.	Acids, alkalis, salts, esters, most hydrocarbon solvents.
Charlab	Charlotte Chemical Laboratories, Charlotte, N. C.	Chemical putty.	
Chemstone	Johns-Manville Sales Corp., New York, N. Y.	Pressed sheets made from asbestos, cement and inert mineral filler.	Mild acids and alkalis.

Materials	Manufacturer	Description	Most Important Applications
Compo-Bond	Ceilcote Co., Cleveland, Ohio	Silicate bonding cement, liquid and powder.	Mineral acids, salts, hydrocarbons, mixed acids.
Conductoplast	Atlas Mineral Products Co., Mertztown, Pa.	Room temperature setting highly conductive plastic cement.	Non-oxidizing, hydrofluoric acid, organic acids, alkalis, salts, organic solvents.
Crown	Robinson Clay Products Co., Akron, Ohio	High temperature bonding mortar.	Acids, alkalis.
Duralon	U. S. Stoneware Co., Akron, Ohio	Furan base resin cements.	
Durisite	U. S. Stoneware Co., Akron, Ohio	Furan base resin cements.	
Duristone	U. S. Stoneware Co., Akron, Ohio	Furan base floor mastic.	
Duro Standard	Electro Chemical Supply & Engineering Co., Emmaus, Pa.	Sodium silicate cement.	All acids above 3% concentration except hydrofluoric.
Duro-Tite	Electro Chemical Engineering & Mfg. Co., Emmaus, Pa.	Plasticized sulphur sewer pipe joint material.	Inorganic acid, salt and alkali wastes.
Duro XXX (Triplex)	Electro Chemical Supply & Engineering Co., Emmaus, Pa.	Sodium silicate quick-setting cement.	All acids except hydrofluoric.
Duron	Electro Chemical Supply & Engineering Co., Emmaus, Pa.	New type synthetic resin. Bonds directly to concrete.	All acids, solvents and mild alkalis.
Fiberglas	Owens-Corning Fiberglas Corp., Toledo, Ohio	Insulating cement, asphalt-type protective mastic.	
Filtros	Filtros Inc., East Rochester, N. Y.	Acidproof cement.	
Flint-Bond	Robinson Clay Products Co., Akron, Ohio	High temperature bonding mortar.	Acids, alkalis.
Furnane	Atlas Mineral Products Co., Mertztown, Pa.	Series of room-temperature setting furane cements.	Non-oxidizing acids, hydrofluoric acid, organic acids, alkalis, salts and organic solvents
G-K	Atlas Mineral Products Co., Mertztown, Pa.	Hot melt filled plastic cement.	Non-oxidizing acids, alkalis, salts.
Harwaco Bond	Harbison-Walker Refactories Co., Pittsburgh, Pa.	High temperature bonding mortar.	Acid fumes at high temperatures.
Insulplast	Atlas Mineral Products Co., Mertztown, Pa.	Room temperature setting, nonconductive resin cement.	Nonoxidizing acids, organic acids, alkalis, salts, organic solvents.
Kabo	Maurice A. Knight, Akron, Ohio	A phenolic base resin cement supplied in powder and liquid form, to be mixed when used.	
Kemo Cement	Electro Chemical Supply & Engineering Co., Emmaus, Pa.	210 deg.F. B&R melting point asphalt cement.	All acids, except highly oxidizing ones and alkalis.
Knight #2 Cement	Maurice A. Knight, Akron, Ohio	A quick-setting silicate cement.	
Knightrobond	Maurice A. Knight, Akron, Ohio	Two sulphur-base cement; No. 6 carbon filler, No. 7 silicate filler.	
Kolmetal	Palladium Mastic Corp. of America, Rutherford, N. J.	Plastic base aluminum cement.	Corrosive salts, oils, hydrocarbon solvents.
Korez	Atlas Mineral Products Co., Mertztown, Pa.	Phenol-formaldehyde; silica aggregate.	Sulphuric, hydrochloric, phosphoric; organic acids; corrosive salts and gases.
Lecite	Electro Chemical Supply & Engineering Co., Emmaus, Pa	Furan-base resin cement.	All alkalis, solvents, and acids except highly oxidizing ones.
Lumnite	Lumnite Div., Universal Atlas Cement Co., New York, N. Y.	Hydraulic cement; powder for mixing with aggregate and water to make concrete.	Weak sulphuric, lactic, carbonic acids.
N-38 Silicate	Philadelphia Quartz Co., Philadelphia, Pa.	Sodium silicate; to be combined with special proprietary quick-setting cements at time of use.	Sulphuric or any other acid, including, organic except hydrofluoric.
N-Series	Union Bay State Chemical Co., Cambridge, Mass.	Neoprene base cements.	
Neobon TC	Atlas Mineral Products Co., Mertztown, Pa.	Chloroprene polymer cement.	Sulphuric, phosphoric acids; alkalis, corrosive salts.
Nu Mastic	Nukem Products Corp., Buffalo, N. Y.	Asphalt base, high temperature cement.	Hydrochloric, sulphuric, nitric, hydrofluoric acids; alkalis.
Nukem All-Purpose	Nukem Products Corp., Buffalo, N. Y.	Resinous cement; chemical setting.	Sulphuric, hydrochloric, hydrofluoric acids; alkalis.
Nukem Silicate	Nukem Products Corp., Buffalo, N. Y.	Silicate cement.	All acids except hydrofluoric, caustic.
Palladium Mastic AG	Palladium Mastic Corp. of America, Rutherford, N. J.	Troweling type or high-pressure spray-type gilsonite plastic cement.	Non-oxidizing acids, alkalis, and salts.
Palladium Mastic Type T	Palladium Mastic Corp. of America, Rutherford, N. J.	Troweling type or high-pressure spray-type cork-filled gilsonite plastic cement.	Non-oxidizing acids, alkalis and salts.
Palladium Mastic 3X	Palladium Mastic Corp. of America, Rutherford, N. J.	Troweling type or high-pressure spray-type cork-filled gilsonite plastic cement.	Non-oxidizing acids, alkalis and salts.
Parral Plastic	Robinson Clay Products Co., Akron, Ohio	High temperature bonding mortar.	Acids, alkalis.
Pecomastic	Pecora Paint Co., Philadelphia, Pa.	Putty; troweling; brushing.	Hydrochloric, acetic, sulphuric acids; caustic soda; ammonia; ammonium chloride.
Penchlor Acid-Proof	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Chemical setting silicate cement.	Most acids except hydrofluoric.
Penchlor Acid-Proof S25	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Chemical setting silicate cement.	Conc. sulphuric acid.
Penchlor Acid-Proof WR	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Chemical setting silicate cement for acids to 1650 deg. F.	Weak acid conditions, except hydrofluoric.
Penchlor FCC	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Chemical setting silicate cement.	For acids to 1650 deg. F.
Pennsalt Furan	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Self-hardening resin, cement.	Most alkalis, solvents and moderately strong acids, except high-oxidizing acids.
Penchlor Fire-Proof	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Chemical setting silicate cement.	Acids.
Pennsalt HF and HFK	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Self-hardening resin cement.	Food acid; phosphoric, hydrofluoric acids.
Pennsalt PRF and PRFK	Pennsylvania Salt Mfg. Co., Philadelphia, Pa.	Self-hardening resin cement.	Most acids, alkalis and solvents except some high oxidizing acids.
Permanente 165	Kaiser Alum. of Chem. Sales, Inc., Chem. Div., Oakland, Calif.	Periclase ramming mix (95% MgO) chemical setting.	Basic steel furnaces—basic steel slags, ferroalloy slags.
Permanente 84	Kaiser Alum. of Chem. Sales, Inc., Chem. Div., Oakland Calif.	Periclase ramming mix—chemical setting.	Basic steel furnaces—basic steel slags, ferroalloy slags.
Permanite	Maurice A. Knight, Akron, Ohio	Furan base resin cement.	
Plasbestos	Atlas Mineral Products Co., Mertztown, Pa.	Troweling-type plastics cement.	Non-oxidizing acids, alkalis, salts, hydrocarbon solvents.
Plastite	U. S. Stoneware Co., Akron, Ohio	Caulking putty.	
Plasul Basolit	Nukem Products Corp., Buffalo, N. Y.	Plasticized sulphur-silicate cement.	Sulphuric, hydrochloric, nitric acids.
Pliobond	Goodyear Tire & Rubber Co., Akron, Ohio	General purpose bonding cements.	Dilute acids, dilute alkalis, water, oils.
Pliogrip	Goodyear Tire & Rubber Co., Akron, Ohio	Laminating adhesives.	Dilute acids, dilute alkalis, water, oils.
Porox	Patterson Fdry. & Machine Co., East Liverpool, Ohio	Silicate cement.	
Quigley	Quigley Co., New York, N. Y.	Acidproof cements.	
Reardon	Reardon, Cincinnati, Ohio	Several types—unmixed and ready mixed.	With limitations: sulphuric, nitric, hydrochloric, lactic and acetic acid.
Redux	Rohm & Haas Co., Philadelphia, Pa.	Metal-to-metal resin adhesive.	
Royal	Robinson Clay Products Co., Akron, Ohio	High temperature bonding mortar.	Acids, alkalis.

S 35 Silicate	Philadelphia Quartz Co., Philadelphia, Pa.	Low alkaline silicate for use with silica cements.	Sulphuric acid, any acid including organic except hydrofluoric.
Sauereisen 31	Sauereisen Cement Co., Pittsburgh, Pa.	Acidproof cement. Sodium silicate base.	Acids except hydrofluoric, solvents, water, oil.
Sauereisen No. 40	Sauereisen Cement Co., Pittsburgh, Pa.	Furan-base resin cement.	All alkalis, solvents and acids except highly oxidizing ones.
Sauereisen 44	Sauereisen Cement Co., Pittsburgh, Pa.	Acid tank sealer. Non-hardening bituminous base plastic.	Acids except hydrofluoric, water.
Sauereisen 46	Sauereisen Cement Co., Pittsburgh, Pa.	Hydrofluoric acid cement. Zirconium base melting compound	All acids, solvents, alkalis, water.
Sauereisen 48	Sauereisen Cement Co., Pittsburgh, Pa.	Joint compound. Sulphur base melting compound.	Acids except hydrofluoric, solvents, alkalis, water.
Sauereisen 49	Sauereisen Cement Co., Pittsburgh, Pa.	Resin base melting compound.	Acids except hydrofluoric, solvents, alkalis, water.
Sealtex	Nukem Products Corp., Buffalo, N. Y.	Cold setting rubberized asphaltic compound.	Hydrochloric, sulphuric, nitric, hydrofluoric acids, alkalis.
Silament	Atlas Mineral Products Co., Mertztown, Pa.	A silicate cement.	Oxidizing acids, non-oxidizing acids, organic acids, salts and organic solvents.
S Special Silicate	Philadelphia Quartz Co., Philadelphia, Pa.	Low alkaline silicate for use with silica cements.	Sulphuric acid, any acid including organic except hydrofluoric.
Stackpole	Stackpole Carbon Co., St. Mary's, Pa.	Carbonaceous cements for carbon, graphite, and carbon-to-metal joints.	
Staminite	Robinson Clay Product Co., Akron, Ohio	Acidproof cement.	
Sulsilo	The Sullivan Co., Memphis, Tenn.	Pre-mixed silicate cement.	
Syntho	Electro Chemical Supply & Engineering Co., Emmaus, Pa	Phenol-formaldehyde resin cement.	Mild alkalis, solvents, and acids, except highly oxidizing ones.
Tegul-Vitrobond	Atlas Mineral Products Co., Mertztown, Pa.	A Thiokol-plasticized sulphur cement.	Oxidizing acids, non-oxidizing acids, salts and alcohol.
Testone	Atlas Mineral Products Co., Mertztown, Pa.	Room temperature setting resin cement.	Non-oxidizing acids, salts and alcohol.
Thermolith	Harbison-Walker Refractories Co., Pittsburgh, Pa.	Cement.	Alkali resistant at high temperatures.
Thermolith Batch	Harbison-Walker Refractories Co., Pittsburgh, Pa.	Cement.	Alkali resistant at high temperatures.
Thiokol	Thiokol Corp., Trenton, N. J.	Liquid (100% solids) rubber polymers.	
Thioment	Atlas Mineral Products Co., Mertztown, Pa.	Room temperature setting Thiokol-based cement.	Non-oxidizing acids, salts and organic solvents.
Transite	Johns-Manville Sales Corp., New York, N. Y.	Asbestos fiber and cement combined under pressure. Pipe, flat and corrugated sheet.	Acid and alkaline fumes.
Vitrex	Atlas Mineral Products Co., Mertztown, Pa.	Sodium silicate; sets by chemical reaction.	Sulphuric, nitric, hydrochloric acids; corrosive gases.
Vitrobond	Atlas Mineral Products Co., Mertztown, Pa.	Sulphur-Thiokol cement.	Sulphuric, nitric, hydrochloric, phosphoric acids; corrosive salts and gases.
Vitromast	Atlas Mineral Products Co., Mertztown, Pa.	On-the-job mixed trowel-type plastic cement.	Non-oxidizing acids, alkalis, salts and alcohol.
Vitroplast	Atlas Mineral Products Co., Mertztown, Pa.	Room temperature setting plastic cement.	Non-oxidizing acids, chlorine dioxide, organic acids, weak alkalis, salts and hydrocarbon solvents.
Wedgetite	Electro Chemical Supply & Engineering Co., Emmaus, Pa.	Thiokol-sulphur base cement for joining bell and spigot pipe.	All inorganic acids except hydrofluoric, over 30% nitric and over 50% sulphuric acids.

CERAMICS

Aco	Custodis Construction Co., New York, N. Y.	Acidproof brick and packing rings.	Sulphuric, hydrochloric, phosphoric and nitric acids; caustic soda; pickling solutions.
Alsop Glass Lining	Alsop Engineering Co., Milldale, Conn.	Glass-lined tanks, mixers and filters.	
Amersil Fused Silica	Amersil Co., Inc., Hillside, N. J.	Fused silica ware. Pans, pipes, gas coolers, absorbers, insulators, tubes, plates.	
Carrara	Pittsburgh Plate Glass Co., Pittsburgh, Pa.	Structural glass, flat or bent.	
Ceratherm	U. S. Stoneware Co., Akron, Ohio	Ceramic ware. Process equipment.	
Ceraware	General Ceramics and Steatite Corp., Keasbey, N. J.	Chemical stoneware. Towers, tanks, pumps, etc.	Hot, wet chlorine; hydrochloric, nitric acids; hydrogen peroxide; bromine; sodium hypochlorite.
Cerawite	General Ceramics and Steatite Corp., Keasbey, N. J.	Chemical porcelain. Piping, valves, etc.	Hydrogen peroxide; hydrochloric, nitric, organic, sulphuric acids; aqua regia.
Claycraft	Claycraft Co., Columbus, Ohio	Acidproof brick.	Common acids and alkalis, any concentration.
Duro	Harbison-Walker Refractories Co., Pittsburgh, Pa.	Vitreous, acidproof brick.	Sulphuric, hydrochloric, nitric acids; organic acids; certain alkaline solutions.
Fiberfrax	Carborundum Co., Perth Amboy, N. J.	Aluminum-silicate fibers. In bulk for insulation at high temperatures.	
Fiberglas	Owens-Corning Fiberglass Corp., Toledo, Ohio	Fibrous glass cloth and mat. Air filters, thermal insulation, tower packing, filter cloth.	
Filtros	Filtros Inc., East Rochester, N. Y.	Porous silica filter and diffuser plates and special shapes.	All acids except hydrofluoric.
Filtros 35	Filtros Inc., East Rochester, N. Y.	Porous chemical porcelain.	Acids, hydrogen peroxide.
Filtros cement	Filtros Inc., East Rochester, N. Y.	Silicate base cement.	All acids except hydrofluoric.
Glascote	Glascote Products, Inc., Cleveland, Ohio	Borosilicate glass lining fused to steel.	Hydrochloric, organic, sulphuric, nitric acids; chlorine; pharmaceuticals.
Glassed Steel	The Pfaudler Co., Rochester, N. Y.	Glass fused to steel. Reactors, storage tanks, pipe, fittings, valves, heat exchangers, condensers, columns, evaporators, pumps.	All acids except hydrofluoric. Alkaline solutions to pH 12 and to 212 deg. F.
H-W Chromex Refractory	Harbison-Walker Refractories Co., Pittsburgh, Pa.	Lactic-carbonic.	
H-W Castables	Harbison-Walker Refractories Co., Pittsburgh, Pa.	Lactic-carbonic.	
Hanovia Fused Quartz	Hanovia Chemical & Mfg. Co., Newark, N. J.	Transparent fused quartz in all shapes.	
Illinois	Illinois Electric Porcelain Co., Macomb, Ill.	Ceramic chemical porcelain. Pipe, valves, fittings.	Acids (except hydrofluoric).
Knight-Ware	Maurice A. Knight, Akron, Ohio	Chemical stoneware. Tanks, kettles, pipe, fittings, valves, towers, coils, filters, etc.	
Lapp Porcelain	Lapp Insulator Co., Le Roy, N. Y.	Chemical porcelain. Pipe, fittings, valves, tower packing, special shapes.	Hydrochloric, sulphuric, nitric acids; mixed acids; chlorinated hydrocarbons; wet chlorine.
Locke Porcelain	Locke Inc., Baltimore, Md.	Chemical porcelain. Balls for ball mills, brick, piping, valves, containers.	All acids except hydrofluoric.
Logan	Logan Clay Products Co.	Vitrified clay pipe	Acids, alkalis.
Pennvernon	Pittsburgh Plate Glass Co., Pittsburgh, Pa.	Window glass, flat.	
Permaglas	A. O. Smith Corp., Milwaukee, Wis.	Glass-lined steel equipment.	
Permanente chrome Periclase Brick	Kaiser Alum. & Chem. Sales, Inc., Oakland, Calif.	Chromite and periclase brick (chromite predominating).	Basic steel furnaces, cement kiln hot zones.

Materials	Manufacturer	Description	Most Important Applications
Permanente Periclase Brick	Kaiser Alum. & Chem. Sales, Inc., Oakland, Calif.	Periclase (crystalline MgO) refractory brick.	Basic steel furnaces, cement kiln hot zones—copper furnaces.
Permanente Periclase-Chrome Brick	Kaiser Alum. & Chem. Sales, Inc., Oakland, Calif.	Periclase and Chromite brick (periclase predominating).	Basic steel furnaces, cement kiln hot zones—basic slags, cement clinker.
Pfaudler	The Pfaudler Co., Rochester, N. Y.	Glass-lined steel equipment. Tanks, pipe, fittings, valves.	Hydrochloric, sulphuric, nitric, phosphoric, acetic, chromic acids.
Pittsburgh Plate Glass	Pittsburgh Plate Glass Co., Pittsburgh, Pa.	Polished plate glass, flat or bent.	
Pyrex	Corning Glass Works, Corning, N. Y.	Glass. Pipe, fittings, sight glasses, gage glasses, heat resistant plate.	
Robinson	Robinson Clay Products Co., Akron, Ohio	Vitrified clay pipe.	Acids, alkalis.
Screw Seal	Robinson Clay Products Co., Akron, Ohio	Acid resisting vitrified clay pipe.	Acids, alkalis.
Slip Seal	Logan Clay Products Co.	Pre-cast bituminous joint pipe.	
Tex-Vit	Texas Vitrified Pipe Co., Mineral Wells, Texas	Vitrified clay pipe.	Acids, alkalis.
U. S. Chemical Stoneware	U. S. Stoneware Co., Akron, Ohio	Chemical stoneware. Tanks, kettles, pipe, fittings, valves, pumps, coils, filters, etc.	
U. S. Chemical Porcelain	U. S. Stoneware Co., Akron, Ohio	Chemical porcelain filters, tanks, pumps, valves, etc.	
Vitreo	Vitreous Steel Products Co., Cleveland, Ohio	Porcelain enamel drying trays.	Blue trays: neutral salts and solutions. Brown trays: acids except hydrofluoric and certain grades of hot phosphoric.
Viteosil	The Thermal Syndicate Ltd., New York, N. Y.	Vitreous silica, approx. 99.8% silica; pipes and vessels up to 50 gal. capacity; 30 in. dia., 10 ft. length.	Hydrochloric, phosphoric, perchloric, nitro-hydrochloric acids; chlorine; phosgene.
Vitreous Enamel	Vitreous Enameling & Stamping Co., New York, N. Y.	Enameled tanks and specialties.	
Vycor	Corning Glass Works, Corning, N. Y.	96% Silica glass. Tubing, rods, flat ware, various shapes.	
Wylam Acid	Harbison-Walker Refractories Co., Pittsburgh, Pa.	Acidproof brick.	Sulphuric, hydrochloric, nitric and organic acids; certain alkaline solutions.
PLASTICS			
Ace-Flex	American Hard Rubber Co., New York, N. Y.	Thermoplastic-polyvinyl chloride tubing.	Alkalis, mineral acids, aliphatic and aromatic hydrocarbons, oxidizing and reducing agents.
Ace-Parian	American Hard Rubber Co., New York, N. Y.	Polyethylene-pipe. Pipe fittings and valves.	Almost all alkalis and acids, water and most non-hydrocarbon solvents.
Ace-Riviclor	American Hard Rubber Co., New York, N. Y.	Rigid polyvinyl chloride pipe and tubing.	Almost all alkalis, mineral acids, aliphatic and aromatic hydrocarbons, water and alcohol.
Ace-Saran	American Hard Rubber Co., New York, N. Y.	Vinylidene chloride. Pipe, pipe fittings, valves, tubing, tube fittings.	Almost all mineral acids, aliphatic and aromatic hydrocarbons, phenol, water, Freon gas.
Alathon	E. I. du Pont de Nemours & Co., Wilmington, Del.	Polyethylene. Sheet, rod, tube, molding powders, film, filament. Pipe, pipe lining, gaskets, etc.	Relatively strong alkalis and acids, most non-hydrocarbon solvents, water.
Ampacet	American Molding Powder and Chemical Corp., Brooklyn.	Cellulose acetate molding powder; polystyrene molding powder.	
Ampcoflex	Atlas Mineral Products Co., Mertztown, Pa.	Rigid polyvinyl chloride sheet, rod tubing, pipe and fabricated structures.	Oxidizing acids, non-oxidizing acids, hydrofluoric acid, alkalis, salts, and organic solvents.
Ampipe	Atlas Mineral Products Co., Mertztown, Pa.	Furan plastic reinforced pipe.	Non-oxidizing acids, hydrofluoric acid, organic acids, alkalis, salts and organic solvents.
Ampreg	Atlas Mineral Products Co., Mertztown, Pa.	Room temperature setting casting plastics.	Non-oxidizing acids, organic acids, weak alkalis, salts and hydrocarbon solvents.
Arakite	Ciba Company, Inc., New York, N. Y.	Ethoxyline resin. Adhesives, coatings and casting resins.	Hydrochloric and phosphoric acids, potassium hydroxide, chlorine compounds and chlorine.
Atlastasol	Atlas Mineral Products Co., Mertztown, Pa.	Polyvinyl chloride plastisol.	Oxidizing acids, non-oxidizing acids, alkalis, salts and hydrocarbon solvents.
Atlastavon 1	Atlas Mineral Products Co., Mertztown, Pa.	Polyvinylidene chloride sheet.	Oxidizing acids, non-oxidizing acids, salts, hydrocarbon solvents.
Atlastavon 20	Atlas Mineral Products Co., Mertztown, Pa.	Plasticized polyvinyl chloride sheet.	Oxidizing acids, non-oxidizing acids, alkalis, salts and hydrocarbon solvents.
Atlastavon 30	Atlas Mineral Products Co., Mertztown, Pa.	Compounded polyethylene sheet sprayable granules.	Oxidizing acids, non-oxidizing acids, alkalis, salts and alcohol.
Atlasware	Atlas Mineral Products Co., Mertztown, Pa.	Molded filled phenolic and furan plastics.	Non-oxidizing acids, organic acids, salts, organic solvents.
Boltaron 6200	H. N. Hartwell, Boston, Mass.	Non plasticized polyvinyl, chloride. Sheets, rods, I. P. S. pipe, molded fittings, blocks.	Acetic, hydrochloric, hydrofluoric, nitric, perchloric, phosphoric and sulphuric acids; sodium hydroxide, hydrogen peroxide, alcohol, aliphatic hydrocarbons, distilled water.
Carbo-Kote 6020	Carboline Co., St. Louis, Mo.	Furan type resin applied to numerous coats to build up 1/8 in. lining.	Hydrochloric acid, acetic acid, sulphuric acid up to 50%. Caustic soda, chlorbenzol hot brine.
Catalin Styrene	Catalin Corp. of America, New York, N. Y.	Polystyrene molding powders.	
Chemplas	General Ceramics and Steatite Corp., Keasbey, N. J.	Modified phenolic with coke filler.	Wet chlorine, HF, HCl, $FeCl_3$, SO_2, SO_3 at temps. 48 to 350 deg. F.
Cyclon	Munray Products Inc., Cleveland, Ohio	Polyvinyl chloride tubing.	
Cyclon	Munray Products Inc., Cleveland, Ohio	Plastisols and coatings.	Inorganic acids, alkalis, their salts, aliphatic hydrocarbons.
Cyclothene	Munray Products Inc., Cleveland, Ohio	Polyethylene pipe and tubing.	
Cyclofex	Munray Products Inc., Cleveland, Ohio	Vinyl chloride linings, sheeting, plastisols.	
LC 2103	Dow Corning Corp., Midland, Mich.	Silicone bonding resin for plastic laminates.	Sulphuric, hydrochloric, chromic acids, sodium hydroxide, hydrogen peroxide.
Larex Copolymers (3, +X34, +43E	Dewey & Almy Chemical Co., Cambridge, Mass.	High styrene copolymers.	Sulphuric acid, moisture acids, alkalis, oils, solvents, resistant to aging and to softening at high temperatures.
Larex Copolymers 56LX	Dewey & Almy Chemical Co., Cambridge, Mass.	Polyvinyl acetate emulsion.	Water, common solvents, acids and alkalis, amyl and n-hexyl alcohol, ethylene glycol glycerine, aliphatic hydrocarbons.
Dow Corning Silicone Resin 2103	Dow Corning, Midland, Mich.	Thermosetting silicone resin for bonding glass cloth laminates.	Chlorine, ammonia, salt solution, chromic and nitric acid.
Durez	Durez Plastics & Chemicals, Inc., N. Tonawanda, N. Y.	Molding compound (granular) and resins (lump, liquid, powder) (phenol-formaldehyde condensates.)	Mild acids and alkalis, petroleum and lacquer solvents, vegetable oils.
Duro-Ware	Electro Chemical Engineering & Mfg. Co., Emmaus, Pa.	Furan resin reinforced with glass fabric	Inert to non-oxidizing mineral acids, salts, all alkalis, most solvents, fats, oils, greases.
Duro-Fly	Electro Chemical Engineering & Mfg. Co., Emmaus, Pa.	Thermo-plastic sheet lining material	For inorganic acid, salt and alkali service.
Duro-Kote	Electro Chemical Engineering & Mfg. Co., Emmaus, Pa.	Vinyl linings	Especially for oxidizing acids and salts.

Duro-Kote #57	Electro Chemical Engineering & Mfg. Co., Emmaus, Pa.	Butadiene-styrene resin.	Most acids, alkalis and salts.
Forticel	Celanese Corp. of America, New York, N. Y.	Cellulose propionate.	Fair resistance to dilute acids, bases, salts.
Fuse-On	Electro Chemical Engineering & Mfg. Co., Emmaus, Pa.	Baked epoxy-phenolic resin coating.	Most acids, including nitric and chromic. Solvent and alkalis.
Geon	B. F. Goodrich Chemical Co., Cleveland, Ohio	Polyvinyl chloride-type resins, plastics, latices.	Sodium hydroxide, sulphuric, nitric, hydrochloric and hydrofluoric acids; aromatic, aliphatic hydrocarbons; salt solutions; water; oxidizing, reducing agents.
G-E Molded	General Electric Co., Pittsfield, Mass.	Phenolic, modified phenolic or rubber phenolic. Wood flour, cotton flock, rag or mineral filled.	Dilute acids, bases, hydrocarbons, rayon precipitates, inorganic solvents, alcohol.
Gering EC	Gering Products, Inc., Kenilworth, N. J.	Ethyl cellulose molding and extrusion compounds.	Excellent dimensional stability, resists water, good insulating qualities, lightweight.
Gering CA	Gering Products, Inc., Kenilworth, N. J.	Cellulose acetate molding and extrusion compounds.	Fair resistance to water, dilute acids, salts.
Gering CAB	Gering Products, Inc., Kenilworth, N. J.	Cellulose acetate butyrate Tenite II extruded sections: tool bar stock, solid rods, tubes, pipe.	Excellent resistance to fats, waxes, dilute acids, water.
Gering VCA	Gering Products, Inc., Kenilworth, N. J.	Polyvinyl chloride molding and extrusion compounds, elastomeric and rigid, also extruded sections.	Excellent resistance to mineral acids, alkalis, aliphatic and aromatic hydrocarbon, alcohol.
Gering PS	Gering Products, Inc., Kenilworth, N. J.	Polystyrene molding and extrusion compounds.	Lower alcohols, mineral oils, vegetable oils, glycols, water, acetic and formic acids.
Gering XPS	Gering Products, Inc., Kenilworth, N. J.	High styrene copolymers, molding compounds, extrusions.	High impact, most all acids, alkalis, oils, solvents, water, good dimensional stability.
Gering PE	Gering Products, Inc., Kenilworth, N. J.	Polyethylene molding compounds, also extruded thin gage tubing, sheeting, rods.	Excellent resistance to most all acids, alkalis, water, cold solvents.
Haveg 41	Haveg Corp., Newark, Del.	Molded, asbestos-filled phenolic.	Non-oxidizing acids, salts, hydrocarbons and other solvents.
Haveg 43	Haveg Corp., Newark, Del.	Molded graphite-filled phenolic.	Hydrofluoric acid and its compounds.
Haveg 60	Haveg Corp., Newark, Del.	Molded, asbestos-filled furan.	Non-oxidizing acids, salts, alkalis, alcohols, esters, hydrocarbons and other solvents.
Heresite	Heresite & Chemical Co., Manitowoc, Wis.	Pure phenol-form aldehyde resin.	Sulphuric, organic, fatty acids; all solvents.
JC-60	Atlas Mineral Products Co., Mertztown, Pa.	Hot melt hydrocarbon plastic.	Non-oxidizing acids, organic acids, alkalis, salts and alcohol.
Kel-F	The M. W. Kellogg Co., Jersey City, N. J.	Trifluorochloroethylene polymers (oils, greases, waxes, molding powders, dispersions).	Chemically inert to all strong and weak acids, strong and weak alkalis, both organic and inorganic.
Koroseal	B. F. Goodrich Co., Akron, Ohio	Plasticized polyvinyl chloride. Sheet lining; packing.	Chromic, nitric acid; chrome plating solutions.
Korez S	Atlas Mineral Products Co., Mertztown, Pa.	Casting phenolic plastic.	Non-oxidizing acids, salts and organic solvents.
Kralastic	Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.	Rigid thermoplastic combination of acrylonitrile modified resins and rubber elastomers.	High impact resistance and good chemical resistance to sodium hydroxide, mineral acids, aliphatic hydrocarbons.
Lucite	E. I. du Pont de Nemours & Co., Wilmington, Del.	Acrylic resin; sheets, rods, tubes, moldings.	Weak alkalis and acids, aliphatic hydrocarbons.
Lumarith	Celanese Corp. of America, New York, N. Y.	Cellulose acetate.	Good resistance to fats, waxes; fair to dilute acids, bases, salts, aliphatics.
Lumpane	Celanese Corp. of America, New York, N. Y.	Thermal and electrical insulation. Wire laminated between cellulose acetate sheets.	Good resistance to fats, waxes; fair to dilute acids, bases, salts, aliphatics.
Marvinol	Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.	Thermoplastic polyvinyl chloride resins.	Flameproof rigid and elastomeric products resistant to alkalis, mineral acids, aliphatic and aromatic hydrocarbons, alcohol.
Micarta	Westinghouse Electric Corp., Pittsburgh, Pa.	Laminated plastics, fabric or kraft base. Sheets, channels, angles, molded shapes.	Mild acids, alkalis, organic solvents, water, atmospheric conditions.
Munray Drainage	Munray Products Inc., Cleveland, Ohio	Polyethylene pipe.	Inorganic acids, alkalis, their salts, aliphatic, hydrocarbons.
Nitro-Dur	Electro Chemical Engineering & Mfg. Co., Emmaus, Pa.	Air-dry epoxy-type resin.	Most acids, solvents and alkalis.
Nixon CA (Nixonite)	Nixon Nitration Works, Nixon, N. J.	Cellulose acetate. Sheets, rods, molding powders.	
Nixon CN (Nixonoid)	Nixon Nitration Works, Nixon, N. J.	Cellulose nitrate. Sheets, rods, tubes.	
Nixon EC	Nixon Nitration Works, Nixon, N. J.	Ethyl cellulose. Molding powders.	
NR Pliolite	Goodyear Tire and Rubber Co., Akron, Ohio	Resins and bases for protective coatings.	Dilute acids, dilute alkalis, oil, grease, water.
Nylon	E. I. du Pont de Nemours & Co., Wilmington, Del.	Polyamides; flake, sheet, extrusions, molding; brush filament.	Alkalis, esters, ketones. Some types are resistant to alcohols, most solvents and weak acids.
Palmetto	Greene, Tweed & Co., North Wales, Pa.	Teflon impregnated asbestos.	Acid, solvent and alkali to 550 deg. F.
Permanite	Maurice A. Knight, Akron, Ohio	Filled and fiber reinforced furan resin in fabricated shapes: piping, towers, tanks, etc.	Solvents; all acids and alkalis except oxidizing types.
Phenoline 300	Carboline Co., St. Louis, Mo.	Modified phenolic resin used with various fillers, is trowelable.	Caustic soda, chlorinated solvents, formaldehyde, ketones, ester type plasticizers.
Plastaloy	Atlas Mineral Products Co., Mertztown, Pa.	Reinforced fabricated plastic structures.	Non-oxidizing acids, weak alkalis, salts, and hydrocarbon solvents.
Pla-Tank	The Chemical Corp., Springfield, Mass.	Polyester resin-bonded glass fiber laminate.	Non-oxidizing acids, solvents, alcohols, brine; alkalis and oxidizing acids to 50% at room temp.
Plexiglas	Rohm & Haas Co., Philadelphia, Pa.	Acrylic resin. Cast sheets, rods, molding powder.	Alkalis, non-oxidizing acids, salt water, photographic solutions, low conc. alcohol.
Pliolite S3, S6, S6B	Goodyear Tire & Rubber Co., Akron, Ohio	Resins for rubber reinforcing.	
Pliolite S-4	Goodyear Tire & Rubber Co., Akron, Ohio	Resins and bases for flexible protective coatings.	Dilute acids, dilute alkalis, oil, grease, water.
Pliolite S-5	Goodyear Tire & Rubber Co., Akron, Ohio	Resins and bases for protective coatings.	Dilute acids, dilute alkalis, oil, grease, water.
Pliolite Latices	Goodyear Tire & Rubber Co., Akron, Ohio	Aqueous dispersions of styrene-butadiene for protective coatings.	Dilute acids, dilute alkalis, water and grease.
Pliovic Resin & Latex	Goodyear Tire & Rubber Co., Akron, Ohio	Vinyl copolymer resins and latex.	Dilute acids, alkalis, water, oils.
Polydur	Munray Products Inc., Cleveland, Ohio	Unplasticized rigid polyvinyl chloride pipe.	Inorganic acids, alkalis, their salts, aliphatic hydrocarbons.
Pyroflex	Maurice A. Knight, Akron, Ohio	Thermoplastic modified rubber derivative used as sheet tank linings and coatings.	Most acids and alkalis.
R-M Teflon	Raybestos-Manhattan, Inc., Passaic, N. J.	Packing, gaskets (Teflon).	
Saran	Dow Chemical Company, Midland, Mich.	Vinyl chloride-vinylidene chloride copolymer. Pipe, pipe fittings, tube, tube fittings.	Hydrochloric, sulphuric, nitric acids; phenol; aliphatic and aromatic hydrocarbons.
Sealon	Maurice A. Knight, Akron, Ohio	Plasticized polyvinyl chloride supplied only as sheet tank linings.	Chromic, nitric, mixed acids, alcohol.
Selectron	Pittsburgh Plate Glass Co., Pittsburgh, Pa.	Thermosetting plastic.	
Teflon	E. I. du Pont de Nemours & Co., Wilmington, Del.	Polytetrafluoroethylene. Rods, tubes, sheets, beading, gaskets, thin tapes.	Everything except molten alkali metals.
Tenite I	Tennessee Eastman Corp., Kingsport, Tenn.	Cellulose acetate thermoplastic molding material.	Fair resistance: water, dilute acids, bases, salts, aliphatic petroleum products.
Tenite II	Tennessee Eastman Corp., Kingsport, Tenn.	Cellulose acetate butyrate thermoplastic molding material.	Good resistance: fats, waxes.

Materials	Manufacturer	Description	Most Important Applications
Textolite Laminated	General Electric Co., Pittsfield, Mass.	Phenolic, melamine and silicone laminates. Paper, fabric, asbestos or glass base.	Dilute acids, bases, hydrocarbons, rayon precipitates, inorganic solvents, alcohol.
Uscolite	U. S. Rubber Co., New York, N. Y.	Thermoplastic pipe and fittings.	
Vibrin	Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.	Thermosetting compositions of polyesters and crosslinking monomers used in laminating low pressure molding and casting.	High strength composites in glass cloth laminates. Types of series are flameproof, resistant to acids, alkalis, aromatic and aliphatic hydrocarbons.
Vinlite	Celanese Corp. of America, New York, N. Y.	Mesh reinforced plastic.	Good resistance to fats, waxes; fair to dilute acids, bases, salts, aliphatics.
Westinghouse Micarta	Westinghouse Electric Corp., Pittsburgh, Pa.	Laminated sheets, rods, tubes, special shapes.	Mild acids, alkalis, organic solvents, water, atmosphere.

REFRACTORIES

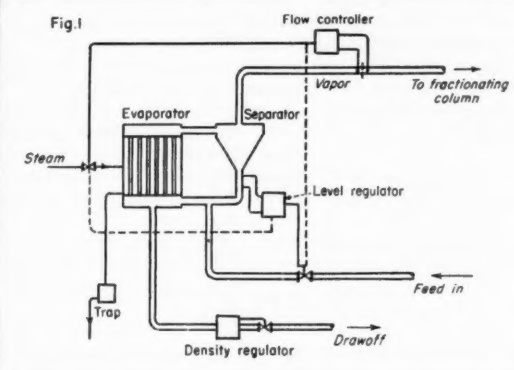
Materials	Manufacturer	Description	Most Important Applications
Aloxite	The Carborundum Co., Perth Amboy, N. J.	Ceramically bonded, fused crystalline alumina grain, in proportion of 15:85. Porous plates and tubes.	Water filtration, acid filtration, including all acids except hydrofluoric, and air and gas diffusion into liquids.
Amersil, Fused Silica	Amersil Company, Inc., Hillside, N. J.	Silicon dioxide. Opaqued and transparent.	All acids, except hydrofluoric and phosphoric (above 400 deg. C.). Most pure molten metals. Most important: hydrochloric, sulphuric and nitric acids; chlorine; magnesium; aluminum.
Amersil, Fused Quartz	Amersil Company, Inc., Hillside, N. J.	SiO_2. Opaqued and transparent.	All acids, except hydrofluoric and phosphoric (above 400 deg. C.). Most pure molten metals. Most important: hydrochloric, sulphuric and nitric acids; chlorine, magnesium; aluminum.
Boyd	Robinson Clay Products Co. Akron, Ohio.	Firebrick.	Acid fumes at high temperatures.
Carbofrax	The Carborundum Co., Refractories Div., Perth Amboy, N. J.	85% SiC and minor amounts of bonding materials. Silicon carbide brick, shapes and cements.	Hydrochloric acid, combustion gases, hydrocarbons, hydrogen, sulphuric acid, and carbon monoxide—all at elevated temperatures.
Cas-To-Fit	Robinson Clay Products Co. Akron, Ohio.	Hydraulic setting castable refractory.	Acid fumes at high temperatures.
Ceraware	General Ceramics and Steatite Corp., Keasbey, N. J.	Chemical stoneware.	Chlorine, hydrochloric acid, bromine, iodine, sulphuric acid, and all organic acids.
Cerawite	General Ceramics and Steatite Corp., Keasbey, N. J.	High-fired chemical porcelain.	Chlorine, hydrochloric acid, bromine, iodine, sulphuric acid, and all organic acids.
Corhart Electroplast	Corhart Refractories Co., Louisville, Ky.	Ramming mix, mullite-corundum base. Thermal setting.	Acid fumes at high temperatures.
Corhart Standard Electrocast	Corhart Refractories Co., Louisville, Ky.	Mortar, mullite-corundum base. Thermal setting.	Acid fumes at high temperatures.
Corhart Standard Electrocast	Corhart Refractories Co., Louisville, Ky.	Refractory blocks, mullite-corundum base. Thermal setting.	Acid fumes at high temperatures.
Corhart Zac Electrocast	Corhart Refractories Co., Louisville, Ky.	Refractory blocks, zirconia-corundum. Fused cast.	Molten magnesium chloride.
Flint-Cast	Robinson Clay Products Co. Akron, Ohio.	Castable refractory, hydraulic setting.	Acid fumes at high temperatures.
Flintex	Robinson Clay Products Co. Akron, Ohio.	Firebrick.	Acid fumes at high temperatures.
Flint-Patch	Robinson Clay Products Co. Akron, Ohio.	Plastic firebrick.	Acid fumes at high temperatures.
FRC	Robinson Clay Products Co. Akron, Ohio.	Firebrick.	Acid fumes at high temperatures.
Logan	Logan Clay Products Co.	Firebrick.	Acid fumes at high temperatures.
Monofrax	The Carborundum Co., Refractories Div., Perth Amboy, N. J.	Fused cast alumina refractories. Brick and blocks	Molten slags, molten glasses, molten metallic oxides, molten metallic silicates, combustion gases and chlorine—all at high temperatures.
Mullfrax	The Carborundum Co., Refractories Div., Perth Amboy, N. J.	Bonded electric furnace mullite. Brick, shapes, and cements.	Steam, hydrogen, carbon monoxide, hydrocarbons—all at high temperatures—molten coal and oil ashes.
No. 1 Savage	Robinson Clay Products Co. Akron, Ohio.	Firebrick.	Acid fumes at high temperatures.
Ohio Woodland	Robinson Clay Products Co. Akron, Ohio.	Firebrick.	Acid fumes at high temperatures.
Patchtite	Robinson Clay Products Co. Akron, Ohio.	Plastic firebrick.	Acid fumes at high temperatures.
Permanente Periclase, Chrome Periclase, Periclase Chrome Refractory Brick, Mortars & Ramming Mixes	Kaiser Aluminum & Chemical Corp., Chemical Div., Oakland, Calif.	Magnesia and magnesia-chrome brick, mortars, ramming mixes and castable materials (made from high purity synthetic MgO)	Resists oxidizing atmospheres and extremely high temperatures. Used in contact with basic materials in steel and non-ferrous metal furnaces, rotary kilns, glass furnaces, pulping furnaces, etc.

Refrax	The Carborundum Co., Perth Amboy, N. J.	Mainly silicon carbide with bonding materials. Special shapes.	Hydrogen cyanide, combustion gases, hydrocarbons—all at high temperatures.
Robinson	Robinson Clay Products, Akron, Ohio.	Firebrick.	Acid fumes at high temperatures.
Robinsul	Robinson Clay Products, Akron, Ohio	Insulating firebrick.	Acid fumes at high temperatures.
Shamva	Mullite Refractories Co., Shelton, Conn.	Mullite-sillimanite type refractories.	Acid fumes at high temperatures.
Taylor Zircon	Chas. Taylor Sons Co. Refractories, Cincinnati, Ohio.	Refractory products made entirely of refined zirconium-silicate.	Calcium metaphosphate, sodium phosphate, sulphuric acid.
Transite, corrugated & flat	Johns-Manville Sales Corp., New York, N. Y.	Made of asbestos and cement, these materials come in large sheets that are structurally strong.	Withstands corrosive action of many liquids, condensates, gases, dusts, vapors and fumes.
Walsh H & B Castable	Walsh Refractories Corp., St. Louis, Mo.	Hydraulic setting, mix and pour castable.	Acid fumes at high temperatures.
Walsh Hi-Lumite	Walsh Refractories Corp., St. Louis, Mo.	Firebrick.	Acid fumes at high temperatures.
Walsh Mort-Airset	Walsh Refractories Corp., St. Louis, Mo.	Airsetting high temperature bonding mortar.	Acid fumes at high temperatures.
Walsh Mullitex Fire Brick	Walsh Refractories Corp., St. Louis, Mo.	Super duty fire clay brick.	Where unusually high temperatures and severe conditions are encountered.
Walsh Plastic Furnace Lining	Walsh Refractories Corp. St. Louis, Mo.	Plastic firebrick.	Acid fumes at high temperatures.

RUBBER

Ace Butyl	Amer. Hard Rubber Co., New York, N. Y.	Lining for special service conditions.	Nitric, phosphoric and other oxidizing acids. Sulphuric acid to 50%. Ferric chloride etc.
Ace Hard Rubber	Amer. Hard Rubber Co., New York, N. Y.	Vulcanized rubber. Rod, sheet, tube, molded parts, linings, pipe, fittings, etc.	Sulphuric, hydrochloric, phosphoric, acetic acids; caustics; salt solutions.
Ace Neoprene	Amer. Hard Rubber Co., New York, N. Y.	Special lining for use where abrasion and presence of oil is a factor.	Hydrochloric acid and sulphuric acid up to 50%. Corrosive services where oil and abrasion is a factor.
Ace Soft Buna-N	Amer. Hard Rubber Co., New York, N. Y.	Special lining for use where abrasion and presence of oil is a factor.	Hydrochloric acid and sulphuric acid up to 50%. Corrosive services where oil and abrasion is a factor.
Ace Soft Rubber	Amer. Hard Rubber Co., New York, N. Y.	Soft rubber. Linings, molded parts.	Sulphuric, hydrochloric, phosphoric acids; caustics; salt solution.
Acidseal E	B. F. Goodrich Co., Akron, Ohio	Natural rubber sheet lining for tanks and misc. metal parts.	Bleach solutions; highly corrosive acid mixtures.
Acidseal MA and PA	B. F. Goodrich Co., Akron, Ohio	Natural rubber sheet lining for tanks and misc. metal parts.	Hydrochloric and phosphoric acids; respectively.
ARco 860 & 864	Automotive Rubber Co., Detroit, Mich., Arco Rubber Processors, Houston, Tex.	Hard rubber sheet lining.	
ARco 812 & 820	Automotive Rubber Co., Detroit, Mich., Arco Rubber Processors, Houston, Tex.	Soft rubber sheet lining.	
ARco 881	Automotive Rubber Co., Detroit, Mich., Arco Rubber Processors, Houston, Tex.	Neoprene sheet lining.	
ARco 1011-C	Automotive Rubber Co., Detroit, Mich., Arco Rubber Processors, Houston, Tex.	Synthetic sheet lining.	
Armstrong	Armstrong Cork Co., Lancaster, Pa.	Buna-N base gaskets.	Aromatic fuels, alkalis, mild acids, alcohols, inorganic salts.
Armstrong	Armstrong Cork Co., Lancaster, Pa.	Neoprene base gaskets.	Alkalis, inorganic salts, mild acids, refined petroleum oils.
Armstrong	Armstrong Cork Co., Lancaster, Pa.	Cork-buna-N base gaskets.	Aromatic fuels, vegetable and petroleum oils.
Armstrong	Armstrong Cork Co., Lancaster, Pa.	Cork-neoprene base gaskets.	Vegetable and petroleum oils.
Armstrong	Armstrong Cork Co., Lancaster, Pa.	Cork-Thiokol gaskets.	Aromatic solvents, common alcohols.
Atlastavon 10	Atlas Mineral Products Co., Mertztown, Pa.	Chloroprene polymer linings.	Sulphuric, phosphoric acids; alkalis, corrosive salts.
Atlastiseal	Atlas Mineral Products Co., Mertztown, Pa.	Elastomeric triple-ply corrosion-resistant membrane.	Non-oxidizing acids, alkalis, salts.
Boston	Boston Woven Hose & Rubber Co., Boston, Mass.	V-belts, conveyor and transmission belt, hose, mechanical goods.	
Chemigum Latices	Goodyear Tire & Rubber Co., Akron, Ohio	Aqueous dispersions of acrylonitrile copolymers for protective coatings.	Acids, alkalis, oils, organic solvents.
Chemigum Rubbers	Goodyear Tire & Rubber Co., Akron, Ohio	Nitrile type oil resistant rubbers.	Gasoline, oil, grease, organic solvents.
Condor	Raybestos-Manhattan, Inc., Passaic, N. J.	Rubber hose, various types.	Acids, paint spray, brewers vinegar, butane-propane, ammonia.
Crane	Crane Packing Co., Chicago, Ill.	Packing and mechanical seals.	
Custoplast	Custodis Construction Co., New York, N. Y.	Soft rubber and neoprene tank linings.	
Dayton	Dayton Rubber Co., Dayton, Ohio	Oilproof rubber V-belt, transmission belt.	
Duro-bond	Electro Chemical Supply & Engineering Co., Emmaus, Pa.	Seamless natural rubber lining.	All acids except highly oxidizing ones.
Duro-Prene HC	Electro Chemical Engineering & Mfg. Co., Emmaus, Pa.	Seamless synthetic rubber lining.	All acids, and salts, except highly oxidizing ones. For heavy linings.
Duro-prene	Electro Chemical Supply & Engineering Co., Emmaus, Pa.	Seamless synthetic rubber lining.	All acids except highly oxidizing ones.
Duro-San	Electro Chemical Engineering & Mfg. Co., Emmaus, Pa.	Saran rubber—sheet lining material.	Inorganic acids (mild oxidants), alkalis, salts, many solvents.
Elprene	Atlas Mineral Products Co., Mertztown, Pa.	Compounded liquid neoprene.	Non-oxidizing acids, alkalis, salts, hydrocarbon solvents.
Firestone	Firestone Tire & Rubber Co., Akron, Ohio	Vibration dampeners, adhesives, sheet, tape, hose, belting, fabric moldings, extrusions, foamed latex, rubber thread.	
Flexlastics	Raybestos-Manhattan, Inc., Passaic, N. J.	Rubber products, molded and extruded shapes.	Elastic materials containing best natural or manufactured rubber to produce flexible and elastic products.
Garlock	Garlock Packing Co., Palmyra, N. Y.	Gaskets, packings, moldings, Klozure oil seals.	
Gates	Gates Rubber Co., Denver, Colo.	Belts, hose, moldings.	Dilute acids and alkalis, mineral oils, chlorinated hydrocarbons, organic peroxides, alcohols.
G. E. Silicone Rubber	General Electric Co., Pittsfield, Mass.	Sheets, extruded shapes, molded parts, coating pastes, foam, gaskets.	Dilute acids and alkalis, mineral oils, chlorinated hydrocarbons, organic peroxides, alcohols.

Materials	Manufacturer	Description	Most Important Applications
Greene-Tweed	Greene, Tweed & Co., No. Wales, Pa.	Packing, gaskets, sheet.	
Hereerol	Heresite & Chemical Co., Manitowoc, Wis.	Butadiene acrylonitrile product. Vulcanized or uncompounded.	Hydrochloric acid, oils, gasoline.
Hewitt	Hewitt Rubber Div., Hewitt-Robins, Inc., Buffalo, N. Y.	Hose, belting.	Acid, alkali, air, water, steam.
Hycar OR	B. F. Goodrich Chemical Co., Cleveland, Ohio	Nitrile type synthetic rubber.	Aromatic, aliphatic hydrocarbons; alkaline, acidic and neutral salt solutions; alcohols and esters; vegetable and mineral oils; alkali solutions.
Hycar PA	B. F. Goodrich Chemical Co., Cleveland, Ohio	Polyacrylic ester type synthetic rubber.	Hot animal and vegetable oils, aliphatic hydrocarbons, air, ozone.
Hydrorings	Atlas Mineral Products Co., Mertztown, Pa.	Natural rubber molded ring gaskets.	Non-oxidizing acids, alkalis, salts.
Jenkins	Jenkins Bros. Rubber Div., New York, N. Y.	Valve disks, tape, moldings, extrusions.	
Johns Manville	Johns-Manville Sales Corp., New York, N. Y.	Gaskets.	
Linatex	Linatex Corp. of America, Rockville, Conn.	Natural rubber—linings for tanks and miscellaneous metal parts.	Most industrial chemicals except strong oxidizing agents. Will withstand temperatures up to 180 deg. F.
Linear	Linear Packing & Rubber Co., Philadelphia, Pa.	Packing.	
Luzerne	Luzerne Rubber Co., Trenton, N. J.	Hard rubber—sheet, rod, tube, molded, pipe and fittings, containers, handmade and turned parts, lining.	Hydrochloric, sulphuric up to 56 deg. Be. Acetic and phosphoric-caustic salt solutions.
Magi-Vule	Magic Chemical Co., Brockton, Mass.	Linings, coatings, cements.	
Manhattan	Raybestos Manhattan, Inc., Manhattan Rubber Div., Passaic, N. J.	Crude and synthetic rubber linings.	Inorganic acids (except highly oxidizing), salts, alkalis; organics except aliphatic, aromatic and chlorinated hydrocarbons.
N-Series	Union Bay State Chemical Co., Inc., Cambridge, Mass.	Neoprene lining compounds for pipes, tanks, ducts, and other process equipment.	Most chemicals, fumes, alkalis, corrosive acids and salts except highly oxidizing.
Neelium	Atlas Mineral Products Co., Mertztown, Pa.	Highly-filled liquid neoprene.	Non-oxidizing acids, alkalis, salts, hydrocarbon solvents.
Neobon	Atlas Mineral Products Co., Mertztown, Pa.	Neoprene-base lining for tanks, fans, fume ducts, etc.	Sulphuric, phosphoric acids; alkalis; corrosive salts.
Neoprene	E. I. du Pont de Nemours & Co., Wilmington, Del.	Crude polymer of chloroprene for compounding and curing.	Caustic solutions, plating solutions, aliphatic hydrocarbons, animal and vegetable fats and oils, dilute mineral acids.
Neoprene	Custodis Construction Co., New York, N. Y.	Synthetic rubber acidproof membrane.	Sulphuric acid, caustic soda, bleach solutions, alcohols.
Paracril	Enjay Co., Inc., New York, N. Y.	Copolymer of butadiene and acrylonitrile. Solid sheets.	Aliphatic hydrocarbons; animal, vegetable and petroleum oils.
Paranite (Gas-Oil Proof)	Raybestos Manhattan, Inc., Passaic, N. J.	V, transmission and conveyor belts. Hose.	Unaffected by solvents and other fluids destructive to rubber.
Paraply	U. S. Stoneware Co., Akron, Ohio	Synthetic rubber compounds.	
Paramount	Paramount Rubber Co., Detroit, Mich.	Neoprene, buna-S, natural rubber. Sheets for tank lining.	
Parlon	Hercules Powder Co., Wilmington, Del.	Chlorinated rubbers. Used as a base for concrete paints.	
Parock	Raybestos Manhattan, Inc., Passaic, N. J.	Hard rubber, oilless bearing.	Any solution not harmful to rubber. Will run submerged indefinitely without lubrication.
Permobond Natural (soft)	U. S. Rubber Co., New York, N. Y.		
Permobond Natural (hard)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-S (soft)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-S (hard)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-A (soft)	U. S. Rubber Co., New York, N. Y.	Linings for tanks, pipe, fittings, valves.	Majority of industrial chemicals except strong oxidizing agents such as nitric and chromic acid, pickling baths, hot acid baths. Withstand temperature to 180 deg. F., special compounds up to 210 deg. F.
Permobond GR-A (hard)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-M (soft)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-P (soft)	U. S. Rubber Co., New York, N. Y.		
Permobond GR-I	U. S. Rubber Co., New York, N. Y.		
Plioweld	Goodyear Tire & Rubber Co., Akron, Ohio	Rubber-lined tanks, pipe, etc.	Hydrochloric, sulphuric, hydrofluoric acids; wet chlorine; bleach solutions; plating solutions.
Quaker	Quaker Rubber Corp., Philadelphia, Pa.	V, conveyor and transmission belts. Hose, mechanical goods.	
Rewbon	Atlas Mineral Products Co., Mertztown, Pa.	Natural rubber.	Sulphuric, hydrochloric, hydrofluoric, phosphoric acids; alkalis; corrosive salts.
Saniprene	B. F. Goodrich Co., Akron, Ohio	Natural rubber sheet lining for tanks and misc. metal parts.	Food products.
Saran	Automotive Rubber Co., Detroit, Mich., Arco Rubber Processors, Houston, Tex. (Licensed applicators)	Saran sheet lining	
Silastic	Dow Corning Corp., Midland, Mich.	Silicone rubber compounded with inorganic fillers.	Hot oils; ozone; hydrochloric, nitric, sulphuric acids; sodium hydroxide.
Superflexite	B. F. Goodrich Co., Akron, Ohio	Flexible, natural rubber sheet lining for tanks, metal parts.	Bleach solutions; highly corrosive acid mixtures.
Stokes	Stokes Molded Prods., Trenton, N. J.	Hard rubber pipe, containers, fittings, moldings and extrusions.	Acids, metallic salt solutions, chlorine solutions, ammonia, caustics.
Stokolite	Stokes Molded Prods., Trenton, N. J.	High impact chemical resistant pails. Dippers and chemical handling equipment and parts.	Sulphuric, hydrochloric and phosphoric acids, aliphatic hydrocarbons, plating solutions, alum.
Tensilgrip	Amer. Wringer Co., Woonsocket, R. I.	Natural and synthetic rubber lined tanks, pipe, pumps, ducts, etc.	
Thermoid	Thermoid Rubber Div., Trenton, N. J.	Rubber hose; various types.	Ammonia, beer and wine, butane-propane gas, CO_2, lactic acid, hydraulic oils, oil and gasoline, lacquers, steam.
Thiokol	Thiokol Corp., Trenton, N. J.	Organic polysulphide rubber. Forms: solid, water dispersion or viscous liquid.	Aliphatic and aromatic hydrocarbons, chlorinated compounds, ketones.
Triflex	B. F. Goodrich Co., Akron, Ohio	Hard rubber layer sandwiched between two soft rubber layers. Sheet lining for tanks and misc. metal parts.	Pickling solutions, alum, hydrochloric and sulphuric acids.
Vistanex	Enjay Co., Inc., New York, N. Y.	Polymerized isobutylene. Viscous liquid to solid, depending on mol. wt.	Sat. sodium chloride, aq. ammonia, aq. ammonium sulphate, aq. lead acetate, 30% hydrochloric acid, 60% hydrofluoric acid, 40% potassium hydroxide, 80% sulphuric acid, 38% sulphuric acid + 14% nitric acid.
Vulcalock	B. F Goodrich Co., Akron, Ohio	Adhesive for rubber-to-steel bonding.	Hydrochloric and sulphuric acids.
Vulcanized	Vulcanized Rubber Co., New York, N. Y.	Hard and semi-hard moldings.	



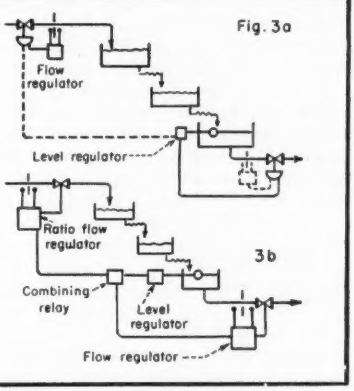


Fig. 1—Evaporation process supplies vapor and concentrate; shows two different automatic control hook-ups.

Fig. 3—(a) Flow-level control with flow and level regulators; (b) similar problem arranged for "exact correction" control.

How Processes Affect Control

Process factors which affect automatic control include the variables to be controlled, the presence or absence of self-regulation, and the process lags and lag combinations which assist or oppose control.

J. B. McMAHON and R. A. ACKLEY

Automatic control is used to produce products of definite specifications —physical, chemical, or both. It is rare, however, that it is possible to apply measurement directly to these factors, and therefore it becomes necessary to select process variables for measurement and control which vary quantitatively with the desired properties. Even where analytical type measurements may be applied to the final product, it is frequently impractical to institute automatic control action from such measurement, owing to the time factors introduced by what are commonly called "process lags." It is generally necessary to resort to the measurement and control of variables throughout a process to which the composition of the final product bears a significant relation and which are substantially linear within the operating range. Some physical effect of chemical change such as temperature, pressure, conductivity, or pH may be used. Most other measurements and automatic control applications are made in order to maintain the physical inventory throughout the process in balance, or for the purpose of providing time for chemical reactions or physical changes to take place.

Without going into a complete discussion of the application of automatic control, it may be stated that "discontinuities" in operation, whether of measurement or automatic-control action, are about the most bothersome factors to deal with. It is highly necessary, therefore, that the variables selected for measurement for automatic control purposes be truly representative of changes in process conditions. Under constant operating conditions, some variables may become constant which do not vary quantitatively with changes in operating conditions. For instance, this is true of the temperature of pure liquids at boiling or freezing points, and of the temperature of steel at the decalescence point. Curves of pH frequently show reversals and irregularities that may make the use of pH impractical as a measurement suitable for automatic-control purposes. The characteristic curve of a pump may be such that the discharge pressure does not vary with volume of flow, and is therefore not significant of process conditions.

Many such troublesome conditions may occur, and care should be exerted to see that they are avoided. It is frequently possible to select another process variable, to use some other type of pumping equipment, or to rearrange the process to avoid such effects. Where they are unavoidable, a great deal of thought should be given to the selection of automatic-control equipment and its action to overcome the difficulties caused by such irregularities.

An example of the need for careful consideration and selection of the variables and points of measurement and control is shown by the evaporator application illustrated in Fig. 1. The evaporator serves to concentrate a feed stock to desired value and to provide uniform rate of feed of vapors to a fractionating column.

There are two feeds to the process —liquid feed and steam; and three

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drawoffs—vapor, process liquid, and steam condensate. This is a case where it is not obvious which measured value should be used to regulate which process factor. Liquid level could be used to control steam, feed, or liquid drawoff. So too, could vapor flow and density. The process as pictured was laid out to minimize unfavorable effects. Rate of vapor flow is the primary control. If the set point is increased, the resulting decrease in liquid level will increase feed flow and higher density of bottoms will increase drawoff. There might be a temporary instability of liquid level, owing to the increased ebullition, which would cause a temporary false increase in liquid level. If so, three-element control could be used to maintain feed flow in direct proportion to vapor flow, with correction from liquid level to account for variations in feed composition.

Assume a different control hookup as shown by the dotted lines. In this case, the rate-of-flow regulator on the vapor manipulates the feed, and the liquid-level regulator the steam. Now, if the set point of the vapor-flow controller is raised, the first effect of the resulting feed increase is to decrease the rate of evaporation, and in all probability to decrease the liquid level, since the cold feed entering will reduce the ebullition in the evaporator, and consequently the liquid level. The decrease in vapor flow will cause the flow regulator to open the feed valve still farther, making the situation worse. The liquid-level regulator also will reduce the steam flow owing to the false liquid-level indication. Eventually the increased feed flow will increase the liquid level, and the liquid-level regulator will increase the steam flow; but in the meantime an excess quantity of liquid has accumulated in the evaporator, which will cause an excess vapor flow until the excess liquid has boiled off, and this excess vapor flow will cause the vapor-flow regulator to shut down on the feed, leading to a diminishing cycle in the opposite direction. Such a control hookup would be extremely difficult to stabilize. It might be possible to do so, but only at the sacrifice of control precision.

In actual operation, even the control hookup described as satisfactory proved impossible to stabilize. We resorted then to the "three-element" type of operation commonly used on high-pressure, high-capacity steam generators. In this combination feed flow is made proportional to vapor flow by means of a ratio flow regulator, with the ratio being changed as necessary by the liquid-level regulator, in order to maintain level.

Similar reasoning applies to other combinations, such as having the density regulator manipulate the steam valve. It might be an improvement to have the density regulator manipulate the feed valve, and the level regulator the drawoff valve. Doing so might reduce some of the system time constants, but only experiment could determine this.

SELF-REGULATION

Self-regulation may be the factor which determines whether or not the application of automatic control is feasible in the presence of other difficulties, such as unsatisfactory measurements or process lags. Self-regulation is defined by the ASME as "a sustained reaction inherent in the process which assists or opposes the establishment of equilibrium." It is probably best understood by considering some typical process examples.

As a simple case of self-regulation, in a section of pipe between restrictions, the pressure of liquid flowing will adjust itself practically instantaneously to equalize flow out with flow in. Liquid level in an open tank will vary with the rates of flow in and out. Every rate of flow in will eventually produce a height of liquid sufficient to cause an equal flow out, assuming sufficient tank height.

Consider some cases where there is no self-regulation: If a tank is closed and subjected to an extraneous pressure which is very high compared to the maximum possible variation in liquid head (such as a high-pressure boiler drum) the change in inflow produced by liquid-level changes will be insignificant, and comparatively small differences between flow in and flow out will cause the drum to flood or go dry. Such a case results also where a constant rate of flow is imposed, for example, in removing the liquid from a tank by means of a constant-displacement pump, or by using a constant rate-of-flow regulator on the outflow. Steering a power-driven boat or an airplane also has no effective self-regulation.

Finally there are processes where the self-regulation is negative. For example, where an air lift is used to remove fluid coming into a vessel, any tendency toward disequilibrium becomes progressively worse. If for any reason the airlift column becomes more highly aerated than is necessary to maintain an equilibrium, the tendency to do so increases, since the pressure at the bottom of the vessel decreases. This tends to increase the air flow, which tends to cause more aeration, dropping the pressure further, and so on.

Many cases are difficult to analyze and yet it is vital that this analysis be made, since the presence or absence of self-regulation in a process or piece of equipment may mean the difference between an operable and inoperable plant whether the control is automatic or manual.

Engine- or turbine-driven pumps or compressors may or may not possess this feature in actual application, depending on the process. If the process is one where constant torque is required regardless of speed (neglecting the relatively small change in torque requirement due to variation in friction with varying speed), then there is no self-regulation. Such might be the case where a steam-engine-driven compressor discharges against a pressure held constant by other means, and it is desired to maintain constant suction pressure. In many cases the full permissible speed variations would produce so small a change in suction pressure that the torque change would be negligible. Therefore the compressor might run at any speed for any cutoff setting. If, however, the suction pressure varies definitely with speed change, the resultant change in torque required might be sufficient to produce appreciable self-regulation.

Chemical reactions may or may not produce self-regulating effects. Generally speaking, endothermic reactions assist equilibrium, while exothermic reactions tend to produce disequilibrium. This is because chemical reaction speed usually increases with increasing temperature. If heat must be supplied to cause the reaction to proceed, then an increase in speed of reaction will not cause an increase in temperature, although it may permit a higher temperature. If, however, increased speed of reaction causes increased temperature, which

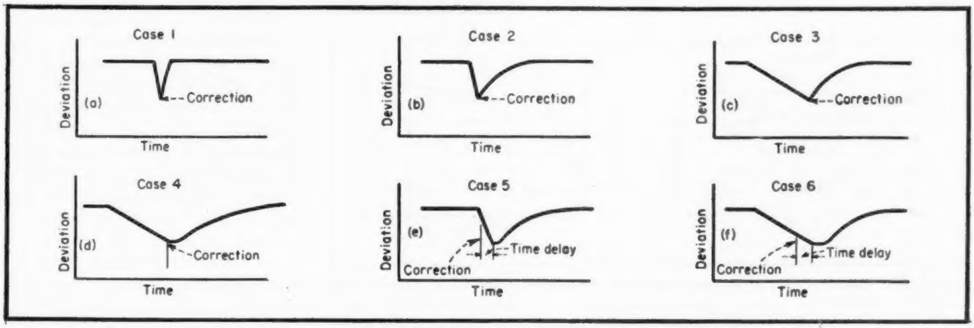


Fig. 2—Process reaction curves for Cases 1-6, showing upset, followed by recovery, with or without finite time delay.

further increases speed of reaction, the tendency toward disequilibrium is self-perpetuating.

The tendency of processes to come to equilibrium, which may be termed "positive self-regulation," is of great assistance in producing successful automatic control. Conversely the tendency toward disequilibrium is very detrimental. Every process should be studied carefully while in the design state in an effort to determine what tendencies exist and if at all possible, to assure positive self-regulation throughout.

PROCESS LAGS

Under balanced operating conditions, there is no analyzable necessity for automatic control in the ordinary continuous process. It is only because of interferences with—or upsets to—balanced conditions that automatic control becomes necessary. The function of automatic control is to prevent deviations from balance, or effect restoration to balance as quickly as possible. Since the process affects the automatic control at the same time that the automatic control is affecting the process, the dynamic response of the process to the restorative action of the automatic control must be taken into account.

The dynamic response of the process, both to the upsets which need automatic-control action, and to the restorative tendency of the automatic-control action, is governed by the capacity, capacitance, resistance to flow, and dead time in the process.

In ASME "Automatic Control Terminology" is the following:

"Delaying or retarding effects associated with industrial process control are caused by capacitance, resistance, and dead time (either separately or in combination) and have often been designated as various forms of 'lag.' These three terms cover the basic concepts involved and, in the interest of clarity, should be used in place of the less exact term lag."

Capacity is a measure of the maximum quantity of energy or material which can be stored. It is measured in units of quantity. The volume capacity of an open tank, for example, is the maximum volume of liquid it will hold without overflowing. The weight capacity of a compressed-air tank is the maximum weight of air which it will hold without exceeding safe pressure.

Capacitance is the change in quantity contained per unit of change in some reference variable. It is measured in units of quantity, divided by the reference variable. The energy or material being contained and the reference variable determine the type of capacitance. Process capacitance may involve different quantities and reference variables, and several types may exist together in one process.

The volume capacitance of an open tank with respect to head is the change of volume of stored liquid per unit change of head, which is equivalent in value to the area of the liquid surface. It should be noted that if the shape of the tank causes the liquid surface area to vary with change of head, the capacitance will vary likewise with head.

The weight capacitance of a gas-filled tank with respect to pressure is the change of weight of stored gas per unit change of pressure.

Resistance is opposition to flow. It is measured in units of potential change required to produce unit change in flow.

Dead time is any definite delay period between two related actions. It is measured in units of time.

The foregoing may be summarized as follows: (1) Capacity is a quantity term. (2) Capacitance is a dimensional ratio. (3) Resistance is a potential factor. (4) Dead time is a finite delay.

These process factors have been referred to in the technical literature on automatic control, but only in rare instances has the discussion considered process time reaction curves only, and where this has been done, it has been on a highly theoretical basis, or for a very limited range of conditions. From the standpoint of the nonspecialist in automatic control, the literature is difficult to grasp and apply.

The time relation between deviation of the measured variable from the desired value, and its response to corrective action, determines the ease or difficulty of either manual or automatic control. It is worthy of note that manual and automatic control are not equally feasible. Automatic control properly selected and applied may easily take care of applications which are difficult, if not impossible, to control manually; and many applications may be handled with comparative ease on manual control which are very difficult for automatic control.

The extremely large number of ways in which the time-delay factors can be combined makes it impossible to discuss all possible combinations of them. There are several combinations, however, which occur commonly and give rise to time relations which may be classified as follows:

Class 1, Fig. 2a—The variable can change quickly, but response to corrective action is just as rapid. This combination may produce an applica-

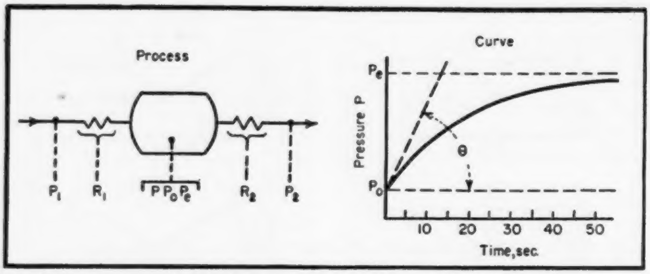


Fig. 4—Reaction curve for single closed tank with compressible fluid, following increase in outlet resistance.

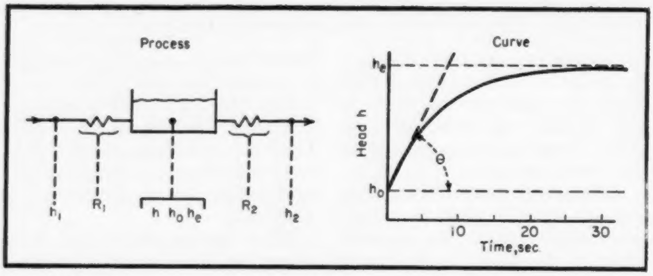


Fig. 5—Reaction curve for single bottom-inlet open tank, following decrease in inlet resistance.

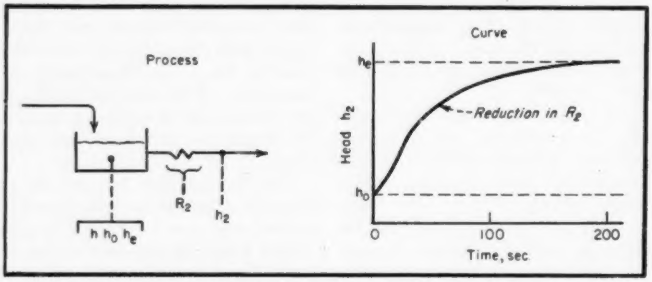


Fig. 6—Reaction curve for single top-fed tank, following increase in outlet resistance.

tion almost impossible to handle with manual control, but fairly easy to handle with comparatively simple automatic-control equipment of the correct type. Such an application requires constant attention and high speed of operation, both of which are difficult for human operators, but which are comparatively easy for properly designed and selected automatic-control equipment.

Class 2, Fig. 2b—The variable can change quickly but response to corrective action is slow. Here, either manual or automatic control is confronted with extreme difficulty. Good control becomes difficult to achieve except under very uniform or very slowly changing conditions.

Where such process conditions occur, a very careful examination should be made to determine if it is not possible to select some other variable which is not subject to such limitations, another point of measurement, or even to rearrange the process or apparatus to reduce the delay. If none of these is possible, the process must be run at a very uniform rate in order to secure good control.

Class 3, Fig. 2c—The variable can change only slowly; response to corrective action starts immediately at maximum rate of change, but equilibrium comes about slowly. When this occurs, good automatic control is generally very easy to secure.

Class 4, Fig. 2d—The variable can change only slowly, and response to corrective action starts slowly, attains a maximum rate of change later, and equilibrium comes about slowly. Here difficulty may be encountered in applying automatic control, although frequently manual control of such an application proves not too difficult. Here again the process design should be reviewed carefully, to determine if some rearrangement may not produce a better reaction time curve.

Class 5, Fig. 2e—The variable can change quickly, but response to the corrective action occurs only after finite time delay. In this case the difficulty of either manual or automatic control is great, and the same condition exists as under Class 2.

Class 6, Fig. 2f—The variable can change only slowly, but response to corrective action begins only after a finite time delay. Again, difficulty is encountered for either manual or automatic control. The finite time delay, which is characterized by the ASME as "dead time," is the most difficult process factor to handle, and always should be eliminated or minimized as far as possible.

Frequently, a rearrangement of automatic controls will suffice to overcome a great many of these difficulties. In Fig. 3a is illustrated a flow and liquid-level control problem. If the setup is made as illustrated in solid lines, the problem of liquid-level control is quite simple. A good controller, free of friction and lost motion, will pass along to the outflow line the quantity entering the tank on which it is installed. If the set point of the rate-of-flow controller is changed, the effect of the change will work through the tasks, being attenuated somewhat in doing so, and will result in the establishment of the new rate of flow out of the final tank.

If, however, the layout is made as shown by the dotted lines, then the level controller is confronted with a very difficult task in maintaining level constant. To allow it to do so will mean that the set point of the flow regulator can be changed only in small increments, spread out over a considerable period. Note that if each tank is equipped with a level regulator which holds level very exactly, it is immaterial whether the flow regulator is installed ahead of or after the tanks.

It is interesting also to note the effect of so-called "exact correction" control on such a process. This type

of control is arranged so that some measurement of changing demand produces a simultaneous and corresponding change in supply. It is very useful where the delay in control is primarily due to the inability of the measuring element of the regulator to detect changes in the measured variable quickly enough, or where there is some irregularity in the response of the measured variable to change. It cannot be used, however, as a short circuit around process delays.

In the case of Fig. 3a, if the equipment were hooked up as shown in the dotted lines, an exact correction type of installation could be made as shown in Fig. 3b. A flow-ratio regulator maintains correspondence as exact as possible between the flow in and the flow out, with a final correction from the level regulator, whose function is to correct the small inevitable discrepancy between the two flows. However, if the set point of the flow regulator on the outflow is changed, the level in the last tank will change in spite of the immediate exact correction change in the flow into the system. The intervening storage capacities of the first two tanks, and the resistance to flow between them, cause time-phase differences which cannot be corrected immediately.

Irregularities or delays in regulator performance produce the same effects as process delays. Sticking and lost motion produce dead time. Sluggishness of response of the measuring element, such as that caused by using a heavy socket or wall on a temperature element, produces the same effect as that of the introduction of another capacity and resistance in the process. In fact, it may be worse, since the thermal capacity of the well, the lack of perfect contact between the well and the element, and the thermal capacity of the element may have the effect of more than one capacity-and-resistance combination. Sluggishness in the final control element may make a difficult application of an easy one.

Arrangement and type of connection of process capacities and resistances have a good deal to do with the ease or difficulty of control. With experience in analysis, a great deal may be predicted from studying the reaction curves of processes. Some typical reaction curves are shown in Figs. 4 to 10.

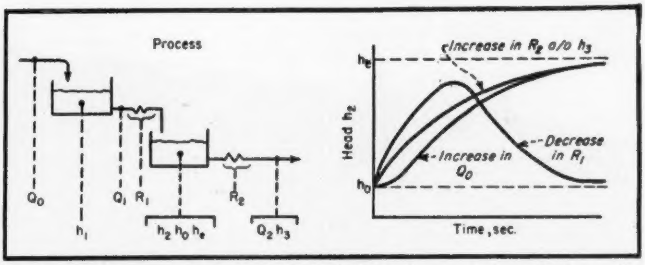


Fig. 7—Reaction curves for two top-fed tanks, following increase in throughput or outlet resistance, or decrease in inlet resistance.

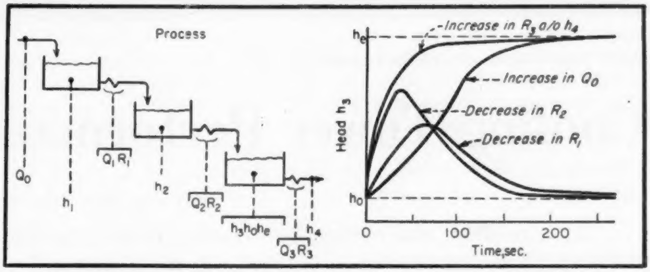


Fig. 8—Reaction curves for three top-fed tanks, following increase in throughput or outlet resistance, or decrease in inlet resistance.

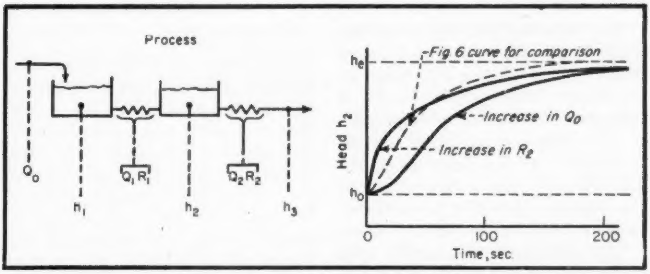


Fig. 9—Reaction curves for two bottom-fed tanks, following increase in throughput or outlet resistance.

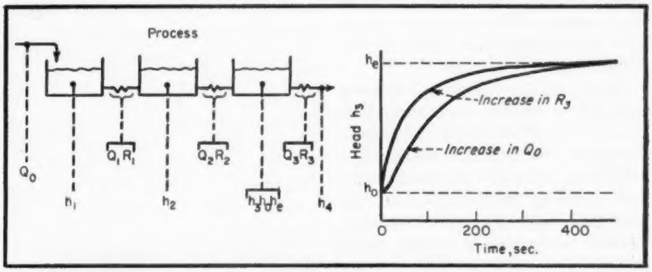
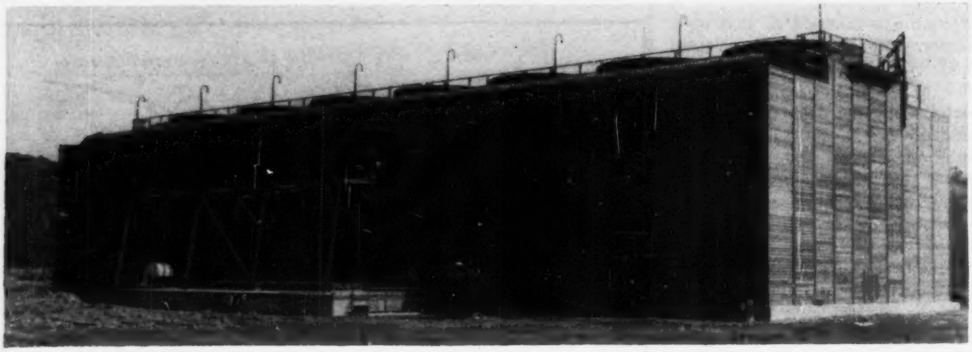


Fig. 10—Reaction curves for three bottom-fed tanks, following increase in throughput or outlet resistance.

While these processes are represented as, and the reaction curves are based on fluid processes, the same type of analysis and representation may be applied to thermal, electrical, and mechanical processes.

In making comparisons with equivalent processes, however, it should be remembered that there is no effect in thermal processes which corresponds

(*Continued on page 348*)



New approach simplifies analysis of . . .

Cooling Tower Performance

You can use this simplified procedure to analyze crossflow and counterflow cooling towers. Based on the unit volume coefficient it eases the correlation of experimental data to theory.

DONALD R. BAKER and LEON T. HART

Ever increasing demands for cooling water by the still expanding chemical process industries pose a problem for engineers. Water, until recently an unlimited raw material in many parts of the country, is no longer limitless in supply. As the demands on the available water supply become heavier the engineer is forced to provide maximum utilization of the water on hand.

One method for reducing the large volume of cooling water required is to remove the water heat load by evaporative cooling in towers. Thus a major portion of the water is restored to a lower temperature level for recycling back to the plant.

As this practice spreads, increasing numbers of engineers are coming in contact with the idiosyncrasies of cooling towers. To help these men in their problems associated with tower design and operating characteristics an improved and easier method has been developed for analyzing cooling tower performance.

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THEORETICAL BASIS

The analysis of cooling tower performance is divided into two separate and distinct parts. The first is the theoretical analysis that considers only mass and energy balances within the system of a particular cooling operation. This analysis is independent of any particular piece of equipment, merely serving as a measure of the degree of difficulty of the cooling problem.

In the second part of an analysis, experimental data indicate the size or extent of the equipment necessary to accomplish the desired performance. This establishes a correlation between the theoretical calculations and the actual performance of a particular piece of equipment. The correlation is purely empirical and may be considered as the calibration of the yardstick for use with a particular piece of equipment.

Cooling tower performance is a function of air wet-bulb temperature. This indicates that the driving force in the cooling process is the enthalpy difference existing between the air film on the water and the main air mass. A consideration of these facts led to the hypothesis that the cooling of water is proportional to the enthalpy potential difference and may be expressed as an over-all coefficient per unit of tower volume.

This hypothesis is compatible with the transfer unit concept. A transfer unit in a cooling tower is large. The essence of the unit volume coefficient is the determination of the transfer unit fraction represented by one cubic foot of tower. By definition this determines the unit volume coefficient as Btu. transferred per cu. ft. of tower per sq. ft. of plan area per Btu. difference in enthalpy potential.

UNIT VOLUME EQUATIONS

The mathematical development of these ideas has been condensed to three basis equations essential to the application of this approach. An energy transfer unit in a cooling tower is determined by the enthalpy change $(\Delta h)_{TU}$ of the air stream that yields Eq. 1.

$$\int_{h}^{h+(\Delta h)} \frac{dh}{h''-h} = 1 \qquad (1)$$

By dividing the transfer unit into α increments and assuming a mean value of the potential difference throughout the fractional transfer unit, Eq. 1 can be solved to give Eq. 2.

NOMENCLATURE

- **a = Water surface exposed to energy transfer per unit volume of tower, sq. ft. per cu. ft.**
- **c = Specific heat of water, assumed to be unity, Btu./(lb.) (deg. F.).**
- **f = Unit volume coefficient, defined as Ka/G.**
- **G = Air rate, lb./(hr.) (sq. ft. of tower cross-section).**
- **h = Enthalpy of main mass of air, Btu./lb. dry air.**
- **h'' = Enthalpy of saturated air at water temperature, Btu./lb. dry air.**
- **K = Over-all average unit energy transfer conductance per sq. ft. of water surface area within the tower, and based upon an enthalpy difference potential, (Btu.)/(hr.) (sq. ft. water surface)/(Btu.)/ (lb. enthalpy potential difference).**
- **L = Water rate, (lb.)/ (hr.) (sq. ft. of tower cross-section).**
- **TU = A subscript denoting a specific increment that yields a transfer unit.**
- **t = Temperature of the water, deg. F.**
- **Z = Height of the active volume of tower, ft.**
- **α = Constant, defined as $[(h''-h)/\Delta t] \times (G/L)$, (Btu. enthalpy potential) /(Btu. transferred.)**

$$\left(\frac{1}{\alpha}\right)\left(\frac{G}{L}\right) \cong \frac{c\Delta t}{h''-h} \qquad (2)$$

If the value of the left-hand side of Eq. 2 is a fractional transfer unit representing 1 ft. of height for 1 sq. ft. of plan area then the right hand side of the equation represents the unit volume coefficient, f. Balancing the energy loss from the water with the energy gain by the air and combining with Eq. 2 gives Eq. 3.

$$\frac{Ka}{G} = \frac{1}{\alpha \Delta Z} = f \qquad (3)$$

Eq. 3 represents the unit volume coefficient and is solved in conjunction with Eq. 2. Other methods of cooling tower analysis integrate in increments of ∂t or ∂h and thus may be applied only to counterflow towers. The unit volume coefficient is calculated by integrating in increments of distance and may therefore be applied to crossflow cooling where a double integration is necessary.

COUNTERFLOW COOLING

The method is applied to a specific problem by selecting some fraction of a transfer unit and determining by mechanical integration the number of fractions represented in the cooling process. The number of fractional transfer units is then used to determine the unit volume coefficient.

The following example illustrates the application of this method:

Table I—Mechanical Integration for Counterflow Tower

Lines of integration, ΔZ...	0	1
Water temperature, deg. F.	85.00	86.53
Enthalpy of water temperature, h''....................	49.43	51.33
Enthalpy of air, h..........	34.09	35.93
$h'' - h$....................	15.34	15.40
$\Delta t = (h'' - h)/10$........	1.53	1.54
$\Delta h = L/G \times \Delta t$..........	1.84	1.85

Assume a counterflow cooling tower 14 ft. high operating on water entering at 100 deg. F. and being cooled to 85 deg. F. Air enters the bottom at 70 deg. F. wet bulb temperature. The liquid-gas ratio is 1.2 lb. of water per lb. of dry air.

A fractional transfer unit may be defined by rearrangement of Eq. 2 as $\alpha L/G = (h''-h)/\Delta t$. If the fractional transfer unit is selected as $\alpha L/G = 10$. it becomes $(h''-h)/\Delta t = 10$ and the water passing through each incremental volume having a height ΔZ will be cooled one degree for each 10 Btu. difference in enthalpy potential.

Neglecting changes of state within the incremental volume, the water leaves the bottom of the tower at 85 deg. F. surrounded by a film of saturated air at the same temperature having an enthalpy (h'') of 49.43 Btu. Air entering the bottom of the tower at a wet-bulb temperature of 70 deg. F. has an enthalpy (h) of 39.09 Btu. Thus the driving force ($h'' - h$) is 15.34 Btu. in the lower incremental volume. The temperature change of the water will be $15.34/10 = 1.534$ deg. F.

Since 1.2 lb. of water passes through the incremental volume for every pound of air, the enthalpy change in the air is $(1.2)\ (1.534) = 1.84$ Btu. per lb. of dry air. Air leaving the incremental volume will then have an enthalpy of $34.09 + 1.84 = 35.93$ Btu. per lb. of dry air.

Water temperature in the next higher incremental volume is $85 + 1.53 = 86.53$ deg. F. and the air film surrounding the water has an enthalpy of 51.33 Btu. per lb. of dry air. The new driving force is $51.33 - 35.93 = 15.40$ Btu. per lb. dry air which determines the temperature change within the second incremental volume. A tabular presentation of the first two steps of this mechanical integration is shown in Table I.

The number of fractional transfer units or lines of integration has been abbreviated to *lines* by usage and will be referred to as such hereafter. Continuation of the mechanical integration to 10 *lines* and interpolation back to 100 deg. F. water temperature gives 9.12 *lines* for the process.

Values are now calculated for use in Eq. 3 to determine the unit volume coefficient. Since the height of the tower is 14 ft., $Z = 14/9.12$ or 1.535 ft. Also $\alpha L/G = 10$ so $\alpha = 8.33$. Therefore, using Eq. 3, $f = 1/(8.33 \times 1.535) = 0.0782$ Btu. transferred per cu. ft. per sq. ft. per Btu. potential difference.

The selection of a larger value for $\alpha L/G$ reduces the size of the incremental volume and increases the accuracy of the mechanical integration. The relationship between size of the incremental volume and the unit volume coefficient value is approximately an inverse ratio so that the value of the coefficient would stay essentially the same.

CROSSFLOW COOLING

The same method of analysis may be applied to crossflow cooling although the calculations are more tedious. Only a single integration is needed in counterflow cooling because conditions are constant across any horizontal section. In crossflow cooling a double integration is necessary due to the gradient pattern of water temperature in the tower as shown in Fig. 1.

The mechanical integration is accomplished by dividing the cross section into a number of columns, each of which is sub-divided into a series of incremental volumes. Hot water entering the top of each column is cooled progressively as it descends. Air at the ambient wet bulb temperature enters each incremental volume of the outside column. As it travels horizontally through the incremental volume its heat content increases by the amount of heat that the water loses during its vertical travel.

Calculation of the outer column is necessary to determine the enthalpy of air entering the next column. Calculations start at the top rather than at the bottom as done in counterflow analysis. The mechanical integration of a crossflow tower must take into account the ratio of length of air travel to water travel. The unit volume coefficient is derived from Eq. 3 as in counterflow cooling.

Using this method of calculation, it is only possible to start with the co-

efficient and solve for the predicted performance conditions by trial and error. However, we can overcome this difficulty by calculating the basic data for a sufficient number of performance conditions and plotting these data as a series of curves.

BASIC CALCULATIONS

The basic calculations consider five variables: hot water temperature, cold water temperature, wet bulb temperature, liquid/gas ratio, and the number of fractional transfer units as represented by the number of *lines* of integration. Fig. 2 is an example from a set of crossflow basic curves illustrating the method adopted for plotting the basic data. This plot represents performance at various temperature conditions at constant values for L/G ratio and line of integration. Experiments show, as will be explained later, that each basic curve also represents cooling tower performance at constant air and water rates.

Cooling tower performance is a function of each of the five variables used in the basic calculations. However, since actual performance is usually expressed in terms of the cold water temperature attained under a specified set of operating conditions the variables affecting performance are:

1. Wet bulb temperature of the entering air.
2. Water loading, gpm. per sq. ft.
3. Cooling range, which defines the heat load if the water rate is specified.
4. Mass air rate.
5. Design characteristic. This includes inherent qualities such as type, size, shape, filling, etc. It also includes the over-all unit volume coefficient.

HOT WATER ADJUSTMENT

The basic curves such as Fig. 2 serve as a yardstick to measure and evaluate these five factors which determine performance. The empirical correlation of actual test data with the curves will show considerable variation as has been previously reported, and the deviation closely follows the hot water temperature. The deviations may be reduced and the correlation accuracy increased by using an empirical hot water correction factor.

Table II is illustrative of the data from test runs made to establish such a hot water correction factor. The data shown cover the two extremes of

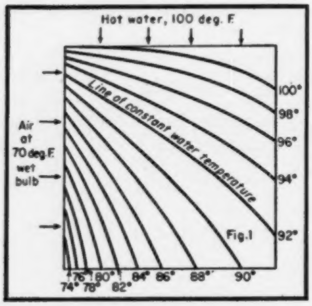


Fig. 1. Typical crossflow temperatures.

hot water temperatures from a total of thirteen runs.

Items 2 through 7 show the actual test data and the corresponding unit volume coefficient. Item 8 shows the cold water temperature that would be predicted from the balance of the data of each run based on an average coefficient. Item 9 shows that these predictions vary from 0.49 deg. F. high to 2.79 deg. F. low and vary with hot water temperature.

Since deviations follow changes in the hot water temperature, the correction is made by selecting some temperature as the base (100 deg. F. in this case) and adjusting all other hot water temperatures to correlate on the same base. The actual hot water temperature can be plotted against the necessary adjustment and the average curve drawn through the plotted points used as the hot water adjustment for the tower. A plot of the actual hot water temperature vs. adjusted hot water temperature as established for the Table II test series is shown in Fig. 3.

Referring again to Table II the adjustment is applied in items 10 through 14. Item 14 shows the deviation between actual and predicted cold water temperatures. An average of all 13 runs (only two shown) is

Table II—Hot Water Adjustment

	Run No. 1	Run No. 13
1. Hot water, deg. F	82.6	140.5
2. Cold water, deg. F	73.3	97.2
3. Wet bulb, deg. F	62.2	70.0
4. Water rate, gpm./sq. ft.	3.12	3.18
5. *L/G* ratio	1.18	1.19
6. Coefficient before	1.28	0.563
7. Predicted C. W. unadjusted	73.79	94.99
8. Deviation from actual C. W.	+0.49	−2.79
9. H. W. adjustment	−0.80	+14.20
10. Adjusted H. W.	81.8	154.7
11. Coefficient adjusted	0.955	0.815
12. Predicted C. W. with adjustment	73.46	97.12
13. Deviation	+0.16	−0.08

now 0.02 deg. F. low. The hot water correction factor varies slightly with changes in type or design of cooling tower.

The deviation of actual performance from the basic curves, as compensated by the hot water correction factor, may be due to both inherent fallacies in the basic theory and to errors resulting from some of the approximations or assumptions entering the calculations. The latter is plausible because the theoretical calculations are based on the assumption that each particle of water is surrounded by a moisture saturated air film at the water temperature.

This represents an ideal condition that cannot exist. Temperature gradients will exist within each particle of water, as well as between the water and film. Also the film will not be completely saturated with water vapor.

The theoretical calculations use film temperature to determine the driving force. Thus the water temperatures shown on the basic curves actually represent film temperatures. The hot water adjustment logically may measure the temperature differential between air film and water which increases with higher hot water temperatures.

AIR AND WATER RATES

Since heat transfer is a function of velocity, it is logical to assume that the coefficient will increase with a rise in mass air velocity. Tests show this to be true. The cooling per pound of water decreases as the water rate increases; therefore the line and coefficient decrease. The variations may be closely approximated using Eq. 4.

$$\frac{L_1}{L_2} = \left(\frac{G_1}{G_2}\right)^n \qquad (4)$$

This point is illustrated by Fig. 4 which was plotted from data on three series of runs. Each series represents a different mass air rate. Runs within each series cover different water loadings at the given air rate. On each run hot water temperatures were adjusted and the water loadings corrected (Eq. 4) to compensate for slight air rate variations. In using Eq. 4 the value of constant *n* was assumed and determined later.

Using the correlation in Fig. 4 it is possible to calculate the amount of water that can be cooled at the three

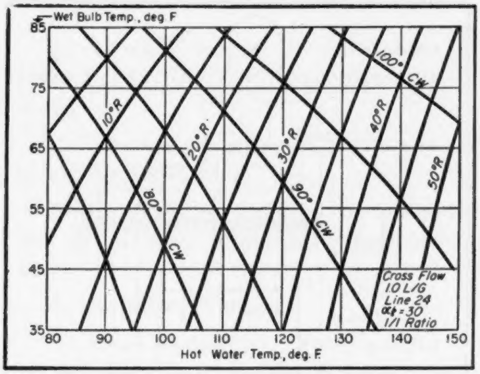


Fig. 2. Basic curves of this type aid crossflow analysis.

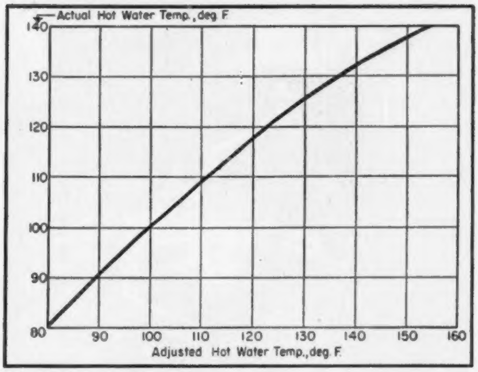


Fig. 3. Adjusted hot water temperatures improve correlation.

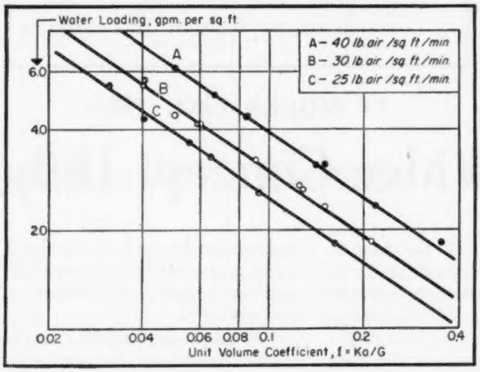


Fig. 4. Water and air rates affect the coefficient.

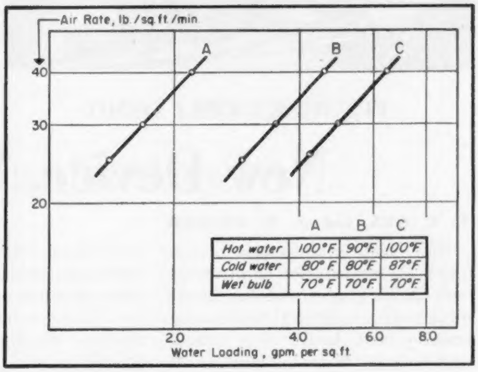


Fig. 5. Air-water ratios for given conditions.

different air rates when certain performance conditions exist. A plot of these calculations is seen in Fig. 5. The slope of the lines represents the value n in Eq. 4. These values are:

Condition A	0.957
Condition B	0.935
Condition C	0.922

The slopes vary slightly but an average value may be used without introducing serious error. Then Eq. 4 can be used to adjust wide air rate variations to some basic mass air rate. This permits use of a single curve to correlate variations of both water and air rates eliminating the need for a curve on each air rate as in Fig. 4.

The value of n varies widely with design. It may be greater or less than unity but is usually lower than in the example.

DESIGN VARIABLES

Now that the development of basic calculations has been considered and correlated to the performance of a specific tower one other point should be emphasized. The same methods of correlation can be used to study the effect of design changes on cooling tower characteristics. These studies show the following:

1. The unit volume coefficient of a spray filled counterflow tower with a pressure distribution system is increased by:
   (a) increasing nozzle pressure
   (b) increasing number of nozzles
   (c) spraying down, rather than up
   (d) decreasing the height of the header.

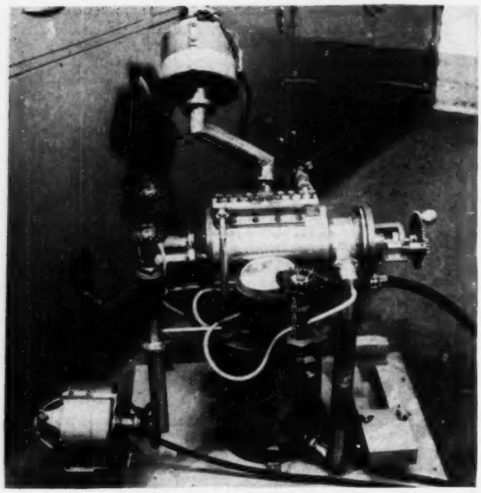
2. Adding filling to a spray filled tower increases the coefficient, but the coefficient continues to vary as in item 1 above.

3. A crossflow tower not having a pressure distribution system is more stable and easy to correlate. The unit volume coefficient does not vary with height.

4. Tests of both crossflow and counterflow filling show that the fill pattern has an effect on the coefficient. Variations of the arrangement of the same amount of fill will effect the coefficient slightly. The greatest variation in performance results from changing the amount of the fill. Increases tend to follow the law of diminishing returns when a constant air velocity is considered. However the additional flow resistance may result in no net gain if comparison is made at constant horsepower input to the fan. The amount of filling in an industrial cooling tower usually is below this point.

5. The effect of increasing tower height is similar to increasing the amount of fill. Usually it is more economical to increase the amount of fill in a lower tower than a high one. Again the law of diminishing returns holds.

This article is a condensation of the paper contributed jointly by the Heat Transfer and Power Divisions for presentation at the Semi-Annual Meeting, The American Society of Mechanical Engineers, Cincinnati, Ohio, June 15-19, 1952.



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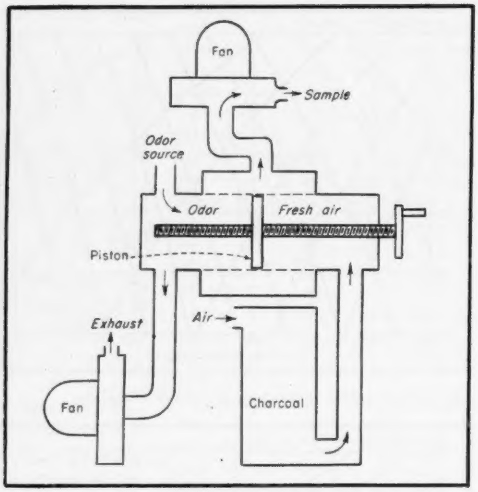

IT WORKS LIKE THIS

New Device, Wider Concept Helps

V. E. GEX and J. P. SNYDER

How does an engineer measure odors? With particles of matter or with specific gaseous contaminants it's often not very difficult to determine emission rates. In fact, very accurate analytical methods are available to measure concentrations of many pollutants and to measure removal efficiencies of equipment installed to reduce concentrations of these contaminants.

MEASUREMENT MUST BE PHYSIOLOGICAL

But odors can be detected only by the physiological sense of smell. At the present time we just don't know what causes a material to give off odors. So if we want to measure odors quantitatively it seems logical that any unit of odor quantity must be related in some manner to the sense of smell.

Finding the threshold point, or point of concentration of odorous material in air at which the odor is barely perceptible, is the usual way to study odors and measure odor strength by dilution techniques. By adopting the odor threshold point as a means of relating odor quantity to the sense of smell, we can define a unit of odor quantity as the amount of odorous material that will contaminate one cubic foot of air to the threshold point.

This definition of an odor unit lends itself to use with dilution techniques, where a sample whose concentration is to be measured is diluted with odor-free air to the threshold point (which, by definition is a concentration of one odor unit/ft.^{3}).

It then follows that—

$$C_o = C_d \times \frac{V_d + V_o}{V_o} = C_d (V_d/V_o + 1) = C_d (D + 1).$$

where

C_o = concentration of original sample, odor units/ft.^{3}

C_d = concentration of diluted sample at the threshold point (= 1 odor unit/ft.^{3}).

V_o = volume of original sample.

V_d = volume of diluting air required to dilute sample to threshold.

D = number of dilutions of sample at threshold ($=V_d/V_o$).

Since C_d is unity, it follows that the odor concentration of the original sample, in odor units/ft.^{3}, is numerically equal to (*number of dilutions at threshold*) +1.

With this concept of odor quantity, we can determine the quantitative rate of odor discharged from a source by multiplying odor concentration by volume rate of discharge in cfm to obtain odor discharge in odor units/min. In this way, we can evaluate and compare the emission rates of various odor sources in a plant. We can also use these rates to determine the quantitative odor reduction brought about by removal equipment like furnaces, activated carbon units, and venturi scrubbers. Odor emission rates so determined can also be inserted in stack diffusion formulas to evaluate the dilution effects obtained by stacks. Since any odor concentration less than unity will be undetectable, it is possible to calculate how far away from the stack the odor will be detected, or how high a stack must be to reduce the maximum concentration below detectable level, under any given set of conditions.

HOW THESE CONCEPTS ARE APPLIED

Any concept of odor quantity needs a suitable method of measuring odor concentrations — like dilution tech-

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V. E. GEX *is in charge of the Odor and Waste Section of the Engineering division of the Procter & Gamble Co.;* J. P. SNYDER *is a chemical engineer in the section. Since P & G does not plan to patent its device, the authors generously offer this complete description of Osmo for the benefit of other process companies interested.*

1. A wide range of intensities from 1:1 to 500:1, with a continuous scale.

2. The use of activated carbon to clean the fresh air.

3. Continuous flushing of odorous air chamber to check contamination.

4. Rapid operation.

5. Semi-portability. Total weight of the entire unit is 100 lb.

6. Utility for process ducts under normal fan suction or pressure.

ITS ADVANTAGES

1. Rather erratic when used for sampling exhausts with a high moisture content, due to condensation on walls of the cylinder.

2. Needs a power supply, not easily carried, limiting the number of locations in which it can conveniently be used.

3. It is expensive—costs $1,900.

4. Does not determine the quality of odors emitted.

5. Human nose is basic element, subject to individual variations.

ITS LIMITATIONS

to Measure Odors Quantitatively

niques — for practical application. Some other methods of odor measurement now being studied, are adsorption of materials followed by chemical analysis, infra-red absorption, optical density, and refractive index measurements. Some of these latter methods are still highly experimental. Others supply useful information on the chemical composition and quantities of material associated with an odor problem. But until we can define more clearly the chemical and physical properties which cause a material to give off odors all of these indirect measurements must be correlated in some manner with the sense of smell if we are to have any quantitative measurement of odor. Consequently, a threshold dilution method of measurement is an invaluable tool in the study of odors in that it measures directly the sum total of all the chemical, physical, and physiological effects which add up to produce odor effect on human beings.

So far, several methods of measuring odor by dilution techniques have been developed[1]—Zwaardemaker's Olfactometer, the Fair-Wells Osmoscope, and bottles evacuated to various degrees and refilled with sample. Some of these were tried by P & G engineers to measure factory odor discharges, but all developed rather severe limitations when used outside of laboratory conditions. Some of these limitations were:

(1) Contamination of testing equipment by the odorous sample; (2) odors in the ambient factory air used for dilution; (3) olfactory fatigue of the operator, either from odors in the ambient air, or from smelling the sample while diluting to the threshold.

NEW TECHNIQUES ARE COMING ALONG

Because of these limitations, we decided to develop a new testing device which would incorporate the following three features:

1. A large continuous flow of odorous sample, to minimize the effects of condensation and contamination of the equipment.

2. A large continuous flow of diluting air, filtered through activated carbon to render it odor-free.

3. A procedure which approached the threshold from the dilute, or odor-free side.

HOW OSMO WORKS

In 1949-1950, P&G designed and built an odor tester which seems to answer most of these needs. It has been nicknamed the "Osmo." Its function is to mix continuously fresh air with odorous air in adjustable and known ratios (see cut). The central element of the Osmo is a cylinder with 528 equally-sized holes. Surrounding this cylinder is an outer cylinder enclosing the mixing chamber. A piston divides the inner cylinder into two sections, and the ratio of holes exposed to each may be varied by moving the piston with an external crank. The odorous air being sampled passes into one end of the cylinder. Some passes into the mixing chamber through the exposed holes, while the remainder is passed out of the unit through an exhaust fan. The "fresh" air is passed through an activated carbon chamber, where atmospheric impurities are removed, into the other end of the cylinder. From there it passes into the mixing chamber, where it mixes with the odorous air and passes through the sampling fan to the nose of the operator.

In operation, the piston is always started from the extreme left hand position in the diagram, so that the operator can breathe fresh air for a few moments. The odorous air is then mixed with the fresh air in slowly increased proportions until the threshold

(Continued on page 372)

Editorial Viewpoints

Double Jeopardy: Engineer-Salesman

In the courts of public opinion all of us are constantly put to double jeopardy in some form or degree. The chemical engineer who designs a plant or process is likely to be held responsible for both theory and practice, hence for the double role of scientist and engineer. The chemical salesman who loses an order is likely to be judged by a double standard of his competence in selling and his technical knowledge of his product.

Ten years or so ago it was extremely difficult, if not impossible, for a sales engineer to win the approval of the Admissions Committee of the American Institute of Chemical Engineers. The production engineer could get by with the specified minimum of training and experience. But many five-figured sales executives were turned down on the basis that they didn't need to know any chemical engineering to sell evaporators or heavy chemicals. Fortunately, all that has changed with the times. Today, we recognize that the sales engineer must often know as much technology—and sometimes even more than his customer.

The same need for technical knowledge is beginning to apply more and more to chemical salesmen. This was clearly emphasized at the first chemical sales clinic recently sponsored by the Salesmen's Association of the American Chemical Industry in New York City. Eight speakers of diversified background and experience contributed to a full day's discussion of sales problems. More than four hundred of the industry's salesmen and sales executives left the meeting inspired with a new sense of personal and professional responsibility.

The greatest uncertainty about business in 1953 is whether the very large volume of civilian goods that can be produced in our tremendously expanded plants can be moved into the hands of the consumers. In this sense, the salesman will be the one who will determine whether the chemical industry will continue its phenomenal growth and development. There is no more challenging career than for those who, at the risk of "double jeopardy," are able to combine competence in technology with the art of salesmanship.

Still On a High Plateau

Preliminary figures for the projected expenditures for capital goods by chemical industries point to a slightly downward trend in 1953. But expansion has been so great in 1952 that even with further growth in chemical markets there won't be the need to add new capacity at quite such a rapid rate.

Managements in the chemical companies that regularly report their plans to McGraw-Hill expect a dip next year of around 13 percent, compared with 8 percent for all manufacturing industries. At that, their capital budgets should exceed \$1300-million as compared with \$1283-million in 1951 and \$1503-million in 1952. The most severe curtailment is in the reported plans for synthetic fibers. Industrial chemicals are off less than 10 percent. Petroleum refiners and food processors plan to buck the trend with increases, respectively, of 5 and 10 percent over 1952.

For the process industries as a whole, it looks like a slight leveling off, but still a high plateau of spending for new plants and equipment.

Two New Ammonia Markets

Perhaps we should not call them new, but they are at least newly industrialized. We refer to urea and nitro-phosphate as novel means by which ammonia can effectively reach the fertilizer market. Just now these two routes to usefulness are being intensively developed and deserve renewed attention.

Allied Chemical is planning to produce at South Point, Ohio, a 12-12-12 fertilizer in which much of the nitrogen will be that which went from ammonia through nitric acid and into the making of available phosphate. There, of course, the nitric is an alternate for a large part of the sulphuric acid normally used. This apparently is the first substantial development by an old-line chemical company of this new technique. It has long been talked about, but not fully developed elsewhere, except experimentally by TVA, and prospectively by one of the farmer co-ops.

Almost simultaneously we hear of the planned manufacture by Grace Chemical Co. of a large tonnage of urea which will be marketed for fertilizer use, largely as ammonia-urea for treatment of superphosphate. This development is particularly important because it represents one of the very first chemical steps by the new subsidiary of W. R. Grace & Co. that has some outstanding leadership, including among others former G. E. president Charles E. Wilson, former Standard Oil vice-president Robert T. Haslam, Col. Bradley Dewey of Dewey and Almy, and the distinguished chemical engineering educator, Edwin R. Gilliland of M. I. T.

It is evident that ammonia is going to reach its markets in these and other new forms successfully. It will meet the tremendous and growing agricultural demand for fertilizer nitrogen even more effectively

than it could have done under older procedures. Thus, the fertilizer business will undoubtedly retain it position as the largest single user of chemicals of any industry group. More and more, chemical managements are making sure that this market grows and continues to be profitable for all, including the average citizen who gets the benefit of a better agriculture through the use of fertilizer chemicals.

Mineral Bottlenecks

All of us have read with more or less interest the much publicized threat that shortages of mineral raw materials may severely limit the growth of certain process industries. Comparatively few of us have known that such limitation is already confronting three divisions of chemical industry in the prospective shortage of chemical-grade fluorine minerals.

Aluminum cannot be made without cryolite, most of which is made synthetically from fluorspar. Much "spar" is also needed for hydrofluoric acid which is largely in demand for petroleum refining and important chemical uses. Water treatment with fluorides may become another substantial user of this element through fluorine-chemical addition to water supplies for urban areas. All of these uses speed up the day when low-grade fluorspar will need to be beneficiated before we can carry on successfully with it. If one goes over the rest of the essential mineral raw materials he finds numerous other examples of this sort. The wise process-industry executive will promptly consider whether any of his essential supplies are similarly threatened.

Better Products, Lower Prices

Soap is not normally thought of as a major product of chemical engineering enterprise. But it is in one way typical of a great achievement of our profession.

Board Chairman R. R. Deupree of Procter & Gamble, in reporting to his stockholders, recently spoke of the long-time price trends in the following language: "The figures will bear repetition. With wages and taxes equivalent to forty times the wages and taxes of 65 years ago, with raw material prices three times what they were, a cake of soap that cost five cents in 1885 costs less than ten cents today, and the quality is immeasurably improved. That's a solid contribution to the American standard of living."

How many other products of chemical engineering can similarly demonstrate the achievement of skilled management in keeping down the cost to the public as the result of applying the highest of engineering talent in the factory and the ablest of technical management in sales and distribution? Some modest bragging is certainly in order, especially at this time when the American public is struggling with ever higher prices. Chemical engineering offsets those threats of high cost more effectively than almost any other single factor.

Scientific Seed-Corn

Manpower statistics are a little discouraging at times as we continue to read how the number of one kind of scientist or another kind of engineer graduating from college next June will be fewer than last June, and the 1954 crop smaller still. Discovering the trend is only the first step. The situation cannot be corrected in a short time. Remember that those college graduates of 1953 and 1954 made up their minds at least five or ten years ago. More important still is the fact that their contemporaries decided at about the same time that they did not care for science or engineering as a lifetime career.

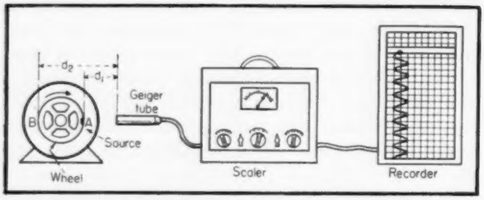
The next time you attend a P.T.A. meeting, or discuss careers with the boy scouts and other youngsters, you can make a real contribution to the profession: Tell them what scientists and engineers had to do with creating some of the products that have contributed most to a comfortable standard of living. Plant a few seeds for the future. Then find out how inspired and inspiring (or otherwise) are the science teachers who are to cultivate that crop in your local community.

Agricultural Research Institute

The newly organized Agricultural Research Institute has held its first meeting in Washington under the sponsorship of its parent organization, the National Academy of Sciences. Industrial memberships had passed thirty prior to the first meeting. A number of these are chemical process industries. More certainly will join as the Institute grows.

Agriculture is already a large market for the process industries. New records are set annually in tonnage of fertilizer chemicals produced and consumed, and the output of pest-control chemicals has also become significant. Nearly 10 percent of the cotton crop this year will have been treated with chemical defoliants' which, according to the U. S. Department of Agriculture, "cause cotton bolls to open faster, speed machine and hand harvesting, reduce trash in machine harvesting, cut down insect and aphid infestation, and aid in cotton pest control." The processing of agricultural products in the production of food and fibers, is, of course, another tremendous chemical market.

The purpose of the new Agricultural Research Institute is to finance "scientific leadership in agricultural policies and practices" under the Agricultural Board of the National Academy of Sciences and the National Research Council. The president of the governing board of the Institute is Roy C. Newton of Swift & Co.; vice-president is Paul D. V. Manning of International Minerals & Chemical Corp., and the secretary is B. S. Clark of American Can Co. Chemical engineers' eyes will be on the Institute as it takes its first steps toward its commendable objectives. We wish it success.



Radioactive Spot Makes Tachometer For High Temperature Use

RALPH L. BELCHER, *Battelle Memorial Institute, Columbus, Ohio.*

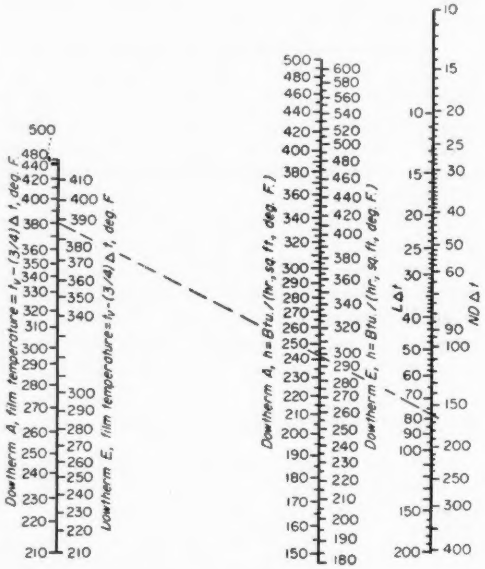
★ **October Contest Prize Winner**

In the radiochemistry laboratory at Battelle we are called upon to apply radioisotopes to problems in mechanical engineering, as well as to problems in physical and chemical research. A problem we recently encountered was that of measuring the speed of revolution of a "floating" wheel inside of an experimental combustor. Efforts to measure the speed of the wheel by the usual electrical methods failed because of the high temperature and the corrosiveness of the combustion gases. Mechanical methods were not adaptable because of the inaccessibility of the wheel. We believed that radioisotopes could be applied successfully to this problem.

If a small quantity of gamma-emitting radioisotope were to be embedded in the periphery of the wheel, it should be possible to follow the rotation of the wheel with a Geiger counter placed outside of the combustor. This is an application of the inverse square law, $(I_1/I_2) = (d_2^2/d_1^2)$, where I_1 = intensity of radiation at distance d_1 from the radioactive source, and I_2 = intensity of radiation at distance d_2 from the radioactive source.

As shown in the diagram, when the wheel is in position A, maximum radiation intensity is detected from the radioisotope source by the Geiger tube. This intensity is recorded as a peak by the continuous recorder. As the wheel rotates, the radioactive source moves farther away from the detector tube. According to the inverse square law, the intensity of radiation at the tube decreases until a minimum value, (d_1^2/d_2^2) of the original intensity, is obtained. This occurs when the radioactive source is at B. At this point, the continuous recorder registers a trough in the intensity plot. As the wheel returns to its starting position at A, the intensity of radiation increases to its original value. This change in intensity with each revolution of the wheel results in a series of peaks and troughs as observed on the recorder tape. By counting the number of peaks over a period of time, the revolutions per minute made by the wheel can be obtained.

An actual setup similar to the one described was made. Cobalt-60 was selected as the radioisotope because of its penetrating radiation, 1.17 and 1.33 million electron-volts. A small piece of cobalt wire (containing cobalt-60), 1mm. in diameter and 2mm. in length, having an activity of one millicurie, was secured to the wheel by peening. This source had a counting rate of approximately 50,000 counts per min. through the 1-in. steel wall of the combustor. A D-34 Geiger tube connected to a Model 1615-A Scaler manufactured by the Nuclear Instrument & Chemical Corp. was used in conjunction with a modified General Electric continuous recorder. With this setup, we were able to record up to 120 revolutions per minute. With a more elaborate electronic system, it should be possible to measure up to 100,000 revolutions per minute, the limiting factors being the diameter of the revolving part being followed and the resolving time of the electronic scaler used.



Heat Transfer Coefficients for Condensing Dowtherm Vapors

ROBERT E. LYON, *University of Michigan, Ann Arbor, Mich.*

Use of condensing Dowtherm vapors as a heat transfer medium has found increasing application in recent years. However, prediction of the theoretical film coefficients is a tedious process and information on the physical properties is often unavailable.

The nomograph above gives a convenient solution of the Nusselt equation[1] for condensing Dowtherm vapors outside horizontal tubes. Here $h = 0.725\ (K/ND\Delta t)^{1/4}$ where K is the product of the physical properties of the particular Dowtherm used, $k^3\rho^2\Delta H_v/\mu$. K is plotted as a function of condensate film temperature for Dowtherm A (diphenyl-diphenyl ether) and for Dowtherm E (ortho-dichloro-benzene).[2]

In the equation, N is the number of horizontal tubes in

a vertical tier, D is the outside diameter in inches, Δt is the difference between the temperature of the vapor and that of the condensing surface in deg. F., and h is the film coefficient in Btu./(hr., sq. ft., deg. F.). Note from the right-hand scale that the nomograph also solves the equation for vertical tubes and streamline flow of condensate[1]. Here $h = 1.13\ (K/L\Delta t)^{1/4}$ where L is the tube length, ft.

As an example, Dowtherm A at 500 deg. F. is to be used to heat an organic material for which close temperature control is required. What condensing film coefficient is expected for a single 1-in. O. D. tube and an average temperature difference of 160 deg. F.? Take the film temperature as $500-(\frac{3}{4})(160) = 380$. Then, as shown by the dashed line, $h = 242$ Btu./(hr., sq. ft., deg. F.).

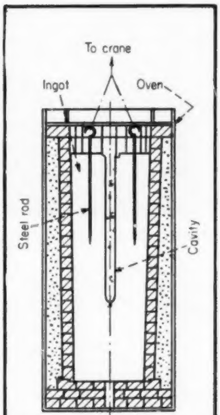
REFERENCES

1. McAdams, W. H., "Heat Transmission," 2nd ed., p. 268, McGraw-Hill Book Co., New York (1942).
2. Physical data supplied by Dow Chemical Co., Midland, Mich.

How to Lift a Cyanamide Ingot When Central Cavity Fails

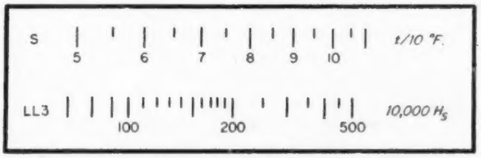
H. Chun Hsu, *Manager, Factory No. 5, Taiwan Fertilizer Co., Ltd., Hsinchu, Taiwan, China.*

Nitrification ovens in our cyanamide plant are of the Frank-Caro type similar to those used in the Niagara Falls Plant of the American Cyanamid Co. When the carbide powder is loaded into the ovens, a cavity is left in the center of the charge. The cavity has two uses: (1) The graphite pencil for starting up the oven reaction is inserted through this cavity; and (2) when the reaction is complete, the cyanamide ingot is lifted from the oven by an ingot lifter which is dropped into this cavity.



Normally, there is no trouble in lifting the ingot. Occasionally, however, the central cavity collapses before the reaction is complete, usually within the first 24 hr. of reaction. When this happened, since the ingot lifter could not be inserted, we had to drill diagonal holes into the ingot. Steel rods were driven into these holes and lashed together with chains to provide a new purchase for the crane. This operation was not always successful and sometimes damaged the oven lining. Furthermore, production time was wasted since the workman had to wait at least 24 hr. to allow the oven cool down before he could start the drilling. A few months ago Er-Wu Ching, superintendent of our cyanamide plant, tried the following method and found it very successful.

As soon as it is found that the central cavity has collapsed, three steel rods 1 in. in diam. and about 3 ft. long, having a hooked upper end, are inserted into the charge, as in the sketch. As collapse of the cavity happens when the charge is still in powder form, there is no difficulty in this operation. When the reaction is complete, the steel rods and the ingot adhere firmly enough for lifting by the overhead travelling crane, but not so firmly that the steel rods cannot be removed from the cyanamide without much trouble, after the ingot is broken into pieces.



Log-Log Slide Rule Gives Moisture Content of Saturated Air

D. S. Davis, *Professor of Chemical Engineering, Virginia Polytechnic Institute, Blacksburg, Va.*

When one of the standard humidity charts is not at hand, values of the moisture content of saturated air at temperatures between 50 and 110 deg. F. can be read conveniently and with sufficient accuracy from the $LL3$ and sine scales of the ever-present log-log duplex slide rule. Set 6 on S over 110 on $LL3$ and read one-tenth of the Fahrenheit temperature t on S opposite 10,000 H_s

Comparison of Actual With Slide Rule Results

Deg. F.	Humidity: Actual	Humidity: Slide Rule	Percent Error
50	0.0076	0.0073	−4.0
60	0.0110	0.0110	0.0
70	0.0157	0.0160	1.9
80	0.0222	0.0226	1.8
90	0.0309	0.0314	1.6
100	0.0428	0.0429	0.2
110	0.0589	0.0575	−2.4

★ November Contest Prize Winner

"Ideas That Will Increase Life of Your Glass-Lined Vessels."

A prize of $50 in cash will be awarded to P. P. Jones, chemical engineer of Pinner, Middlesex, England. Mr. Jones' article will be published in the Plant Notebook section of our January issue.

$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering*, will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. Each month's winner will be announced the following month and published the second following month.

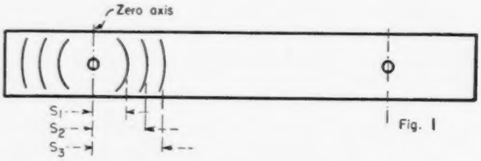
$100 ANNUAL PRIZE—At the end of each year the monthly winners will be rejudged to determine the year's best Plant Notebook article, which will then be awarded an additional $100 prize.

HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Articles which are acceptable but are not winners will be published at regular space rates ($10 minimum).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.

on the *LL3* scale, where H_s, the humidity of saturated air in pounds of water vapor per pound of dry air, is equal to $(18/29)\,[p_s/(14.7-p_s)]$, and where p_s is the saturation pressure of water vapor in pounds per square inch.

The preceding table shows a comparison between actual humidities and those read from the slide rule for temperatures between 50 and 110 deg. F.



"d" Spacing Calculator for X-Ray Diffraction*

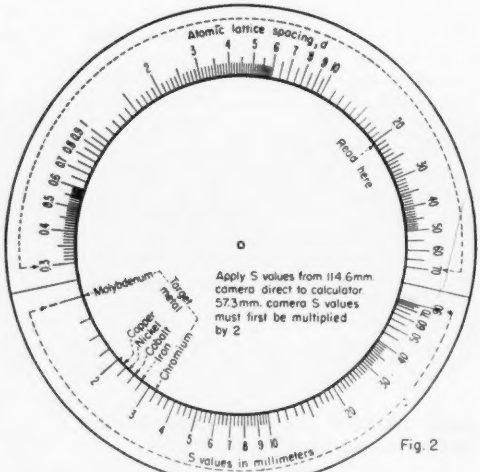
VERN W. PALEN, *Research and Control Instruments Div., North American Philips Co., Mount Vernon, N. Y.*

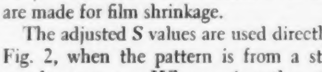
Analysis of x-ray diffraction patterns is expedited by use of the calculator presented here. Fig. 1 above represents a typical x-ray diffraction film. After proper establishment of the zero axis, *S* values as indicated in Fig. 1 (S_1, S_2, S_3, etc.) are measured and recorded. If necessary corrections are made for film shrinkage.

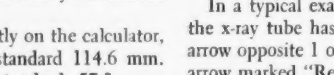
The adjusted *S* values are used directly on the calculator, Fig. 2, when the pattern is from a standard 114.6 mm. powder camera. When using the standard 57.3 mm. powder camera the *S* values must be multiplied by 2 before applying to the calculator.

For use the calculator is best "blown-up" to twice or three times the size given here by photostating. The copy can then be mounted on stiff paper, with the center section cut out and pivoted at the center so that it can be rotated.

In a typical example, suppose that the *S* value is 1 and the x-ray tube has a molybdenum target. Set the "moly" arrow opposite 1 on the S-value scale and read opposite the arrow marked "Read here" the *d* spacing of approximately 20.3. It is obvious, of course, that the calculator has accuracy limitations, particularly in the compressed portions of the logarithmic scales. The device is intended primarily as a quick means for obtaining approximate values where only a rough comparison between patterns is desired.







Condensed Data Aid Selection Of Anti-Freeze Chemicals

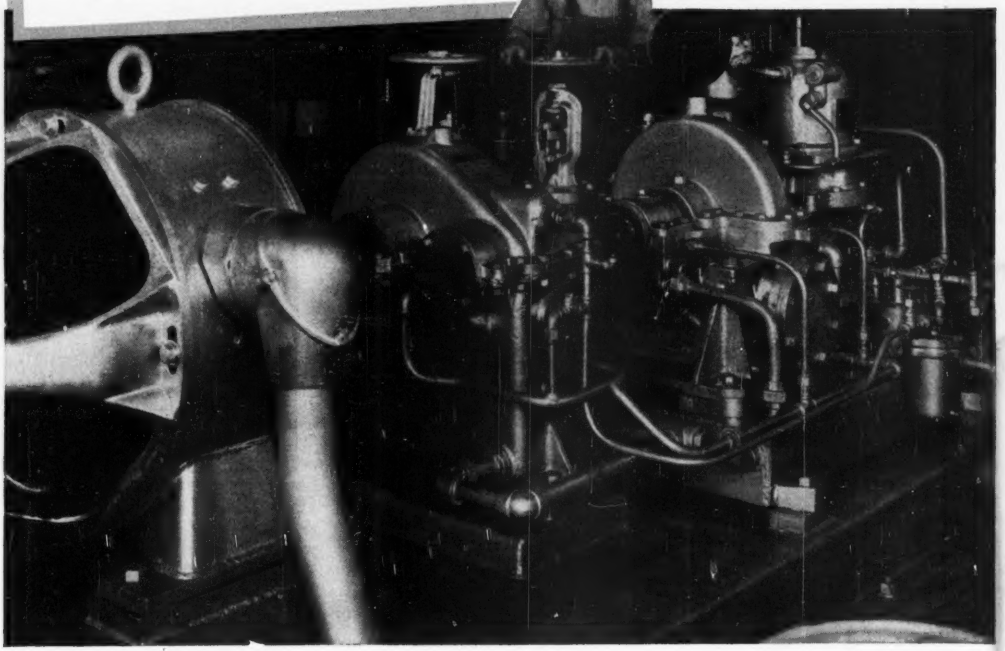
F. M. AHR, *Engineer, Dayton, Ohio.*

The time has now come when we must again face the problem of winter protection against freezing for various kinds of outdoor equipment. Fortunately, it is not nearly so difficult a problem now to provide anti-freezing protection for engine cooling systems and outdoor instrument piping as it was before so many good anti-freeze compounds were commercially available, and before reliable data were available on their properties. There are many applications in most industrial plants where the use of good anti-freeze mixtures can eliminate much grief and worry in sub-freezing weather.

The two curves presented at the left will aid in the wider use of anti-freeze chemicals. Fig. 1 gives the effective freezing point protection of four common commercial products for various percentages of the material dissolved in water. From it one can select the type and concentration needed to suit his climatic range of temperatures. Fig. 2 provides a plot of solution concentration vs. specific gravity, thus permitting a quick check of solution strength by hydrometer.

The four anti-freeze materials selected for use in these solutions include: (1) Methanol (wood alcohol), 97 percent by volume; (2) ethanol, denatured, 180 proof; ethylene glycol, 95 percent by weight; and commercial glycerine, distilled, 95 percent by weight.

Whether operation is continuous or stand-by...



TYPE E turbines can handle it!

In the powerhouse of William F. Schrafft & Sons, makers of the famous "Schrafft's Chocolates," Charlestown, Massachusetts, the Type E turbine is used on a 40-kw, d-c exciter. The turbine exciter is supplementary to a motor-driven exciter for one 750- and two 1000-kw Westinghouse Turbine-Generators.

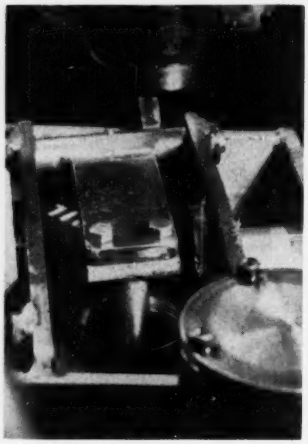
Of this installation, both the Chief Engineer and the Chief Power Plant Operating Engineer stated, "We are impressed by the design, appearance, and smooth-running qualities of the Type E turbine, and also the unique design of the oil-relay governor and forced-feed lubrication which the Type E provides." This all-Westinghouse end of Schrafft's power plant includes a new 1000-kw Westinghouse Geared Turbine-Generator, served by existing Westinghouse switchboard equipment and motor-generator sets.

Here's the general-purpose turbine that meets the many stern demands of modern industry. Regardless of operating conditions, the Type E is built to give dependable, trouble-free, economical performance for long periods of continuous operation . . . or instant operation when used as a stand-by drive.

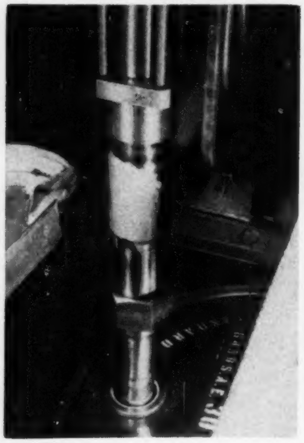
Other types in the complete Westinghouse general-purpose turbine line include heavy-duty and multi-stage units for applications requiring higher temperatures and pressures, higher speeds, greater horsepower, extraction for process applications or higher efficiency than can be obtained with single-stage machines. Get the facts on this broad turbine line . . . call your nearby Westinghouse Office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50540

YOU CAN BE SURE...IF IT'S
Westinghouse

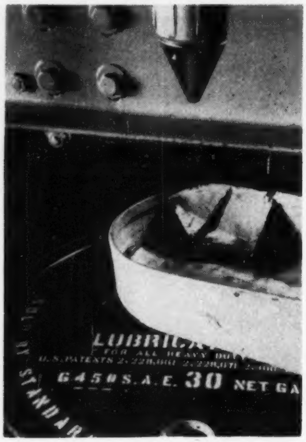
TYPE E **Turbines**



POSITIONING



FILLING



WAITING

Drum Filler Cuts Costs

Machine speeds up filling operation, eliminates overfilling and product waste. All steps are completely automatic. Interlocking controls prevent malfunction.

An automatic drum filler in use at Standard of California's Richmond refinery can fill an average of 1,000 55-gal. drums per 8 hr. shift. Requiring but a single operator, the unit occupies little more space than a manual filling station; has automatic controls with safety interlocks; accommodates a wide variety of drum diameters, heights and bung locations. It is now in its second year of operation, has shown substantial savings in labor costs, reduction of overfill losses, low downtime and maintenance costs.

Three major problems were surmounted in developing a working unit. The machine had to accommodate drums with heights varying several inches, diameters as much as 2 in., and bung offset from the chine of 1-2 in. Compensation for drum tare weights varying up to 6 or 7 lb. had to be provided. Then the problem of foaming during filling, aggravated by speedup, had to be licked.

Solution of these difficulties resulted in a two station machine. The upstream station is the bung locating and drum positioning device. Downstream is the filling station.

Drums travelling in an upright position on a gravity roller conveyor enter the upstream station. Here two pairs of rolls or gates bear on the top chine of the drum. These gates, actuated by hydraulic cylinders, slowly rotate the drum. As the drum rotates an overhead carriage lowers over the drum. A finger on the carriage rides on top of the drum. When the finger drops into the bung, drum rotation stops and the downstream gate opens to permit movement of the drum to the filling station.

When the control circuit receives the proper signal indicating that the previous drum has been filled, the overhead carriage moves forward taking the positioned empty with it and pushing the filled drum off the scale. Then the overhead carriage raises and returns to its original position at the upstream station.

Over the filling scale is a lance which descends through the pre-positioned bung starting the flow of oil at the bottom of its stroke. The filling rate is about 225 gpm. Oil discharges horizontally at the tip of the lance which becomes submerged after a few seconds, minimizing foaming.

Automatic cut-off is achieved in two steps: When the weight is within a few pounds of full measure, oil flow is cut to a dribble which continues until final weight is reached. The filling lance withdraws from the drum and a drip pan swings beneath it to prevent oil dripping on the drum. The full drum is now ready to be pushed from the scale by the next drum.

The control circuit, which is predominantly hydraulic, is completely interlocked. Thus if the supply of drums is interrupted the machine finishes filling the available drums then automatically stops. The machine will proceed automatically when empties reach it again. Inability of the finger to locate a bung merely halts the operation until an operator notices and corrects the situation. If a drum reaches the filling station with the bung out of position so the filling lance cannot drop into the drum then the machine again stops until the situation is corrected. Clogging of the takeaway conveyor also halts the operation.

While this equipment was developed for lubricating oil it is readily adaptable to filling operations on gasoline, chemicals, liquid sugar and possibly asphalts. Best advantage is gained in filling large orders for a single liquid but it is economically practical to handle orders as small as 10-15 drums. One advantage not to be overlooked is the ability to keep personnel at a safe distance when filling hazardous liquids.

Downtime for mechanical reasons has proven to be only about 1 percent. Estimated maintenance costs are $200 per year.—*The Rucker Co., 4228 Hollis St., Oakland 8, Calif.*

Freight Car Doors Are Opened With Ease

Balky freight car doors are easily opened or closed by one man through use of the E-Z Way car door opener, it is said. This device smoothly and powerfully exerts a 4,000 lb. pressure in direct line with the opening and closing channel of all types of freight car doors. The smooth application of pressure ensures that the door will not be forced off the runners.

Made of high-strength alloy steel, the door opener has a built-in lift and holding cam. One man can carry and operate the unit readily since it weighs only 34 lb.—*Penco Engineering Co., 25 California St., San Francisco 11, Calif.*

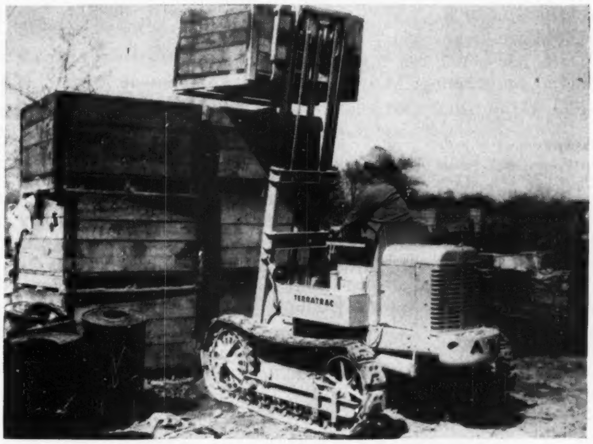
Equipment Cost Indexes

(Marshall & Stevens Indexes, 1926 = 100)

Industry	Sept. 1951	June 1952	Sept. 1952
Average of all	179.1	180.3	180.5
Process Industries			
Cement mfg.	171.5	172.6	172.7
Chemical	179.5	181.0	181.1
Clay products	166.5	167.6	167.7
Glass mfg.	169.6	170.7	171.1
Paint mfg.	172.8	174.3	174.4
Paper mfg.	173.1	174.6	174.7
Petroleum ind.	175.9	177.4	177.8
Rubber ind.	178.3	179.8	180.2
Process ind. avg....	176.9	178.4	178.6
Related Industries			
Elec. power equip...	181.1	182.6	183.0
Mining, milling	180.2	181.7	182.1
Refrigerating	198.6	200.5	200.9
Steam power	168.7	170.3	170.7

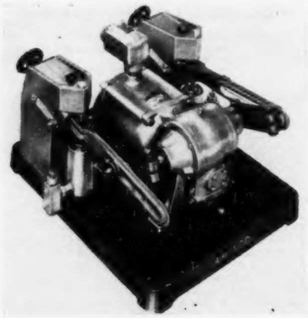
Compiled quarterly for March, June, September and December of each year by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. Indexes are prepared for 47 different industries, from which the eight process and four related industries listed here are selected. Published each month with the latest available revision. For a description of the method of obtaining the index numbers see R. W. Stevens, **Chemical Engineering**, Nov. 1947, pp. 124-6. For a listing of annual averages since 1913 see **Chemical Engineering**, Feb. 1952, p. 191.

IN BRIEF—A capsulated listing of this month's newsworthy equipment.



CRAWLER FORK-LIFT TRUCK DOES ROUGH NECK DUTY

Materials handling under adverse terrain conditions is easily accomplished with this Terra-Lift crawler. Rough ground, mud and snow are readily traversed. Rubber track shoes are available to facilitate operational ease inside warehouses and factory buildings. Now offered with capacities of 2,000 and 4,000 lb.—American Tractor Corp., Churubusco, Ind.



Proportioning Pump Has Novel Adjustment

A recently announced chemical proportioning pump has a stroke adjustment mechanism and indicating scale which remain stationary while the pump is running. The pump is designed so that all the liquid in the cylinder is completely displaced at every stroke. The piston is reciprocated by a positive mechanical linkage to the crank arm. Check valves can be removed easily for cleaning or replacement. Piston and cylinder assemblies for 7,500, and 30,000 psi. working pressures are readily interchangeable in the same pump frame.

Pumps are available in simplex style, duplex style for the same maximum working pressure on each side, and combination duplex style for a different maximum working pressure on each side.—*American Instrument Co., Inc., Silver Springs, Md.*

Compressor Delivers Oil-Free Air

The plague of oil vapor in process air and gases is said to be overcome by a new compressor design. Great care has been taken to isolate the oil-lubricated driving end of the unit from the compressing assembly. Heart of the unit is a carbon cylinder liner which obviates the necessity of a tail rod for the purpose of floating the piston. The burden of carrying the piston-rod assembly is handled entirely by the liner area upon which the piston and metallic rings run.

A distance piece of extra length is interposed between the main frame and cylinder to prevent any portion of the piston rod that enters the splash lubricated main frame from alternately entering the air cylinder stuffing box. An oil baffle on the piston rod also prevents any oil that passes the wiper rings in the main frame from being caried along the piston rod into the stuffing box and cylinder.—*Pennsylvania Pump and Compressor Co., Easton, Pa.*

Dust Collector Elements Are Interchangeable

The Dustmaster unit dust collector offers a high degree of versatility through interchangeability of various elements in the assembly to meet different dust collecting conditions. Any one of five different standard fans and motors, two different filter assemblies, and four standard dust storage containers are designed to fit into the same housing. This means applications involving a large air volume with a small dust load can be dealt with equally as well as those where the air volume is small and the dust load heavy. Likewise, light bulky dust can be handled as readily as heavy concentrated dust.

The flame-proofed filter fabric is freed of dust by means of a new semi-automatic shaking gear.

Units are available with air handling capacities from 175 to 2,000 cfm. Fan motors range in size from ¼ to 2½ hp.—*Dallow Lambert & Co., Ltd., Spalding St., Leicester, England.*

Gas Compressor Produces High Pressures

High-pressure gas compressors manufactured by Andreas Hofer in Germany are now available through a United States distributor. This equipment is capable of compressing gases to 5,000 atmospheres delivery pressure. Output volume at this pressure is relatively low placing the equipment in the experimental class.

The Hofer compressors are piston-type machines having several stages with provision for cooling the compressed gas between stages. The discharge end is fitted with an oil separator for oil remover prior to discharging the gas.

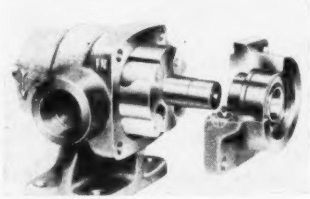
It is expected these units will fill a need in carrying out high-pressure experimental work.—*Chemtech Products Corp., 801 Second Ave., New York 17, N. Y.*

Flat Faced Pipe Joints Now Sealed by O-Rings

The problem of sealing flat faced pipe joints has been eased it is said by the advent of the Dam-Tite O-ring seal. The seal consists of two concentric flat-faced retainer rings of slightly narrower width than the O-ring which is held between them in wedge-shaped grooves. When this assembly is placed between the flat-pipe faces and the flange bolts tightened, the O-ring deforms against the pipe faces forming a seal. The presence of positive or negative pressure inside the pipe tends to further deform the seal to prevent any possibility of leakage.

Normally the O-ring is constructed of rubber composition. However, where required a Teflon O-ring can be used with either Kel-F or Teflon retainer rings.

In contrast to ordinary flat gaskets which require considerable bolt pressure, this seal requires only that the bolts be set sufficiently tight to prevent loosening. No gasket paste or other sealing compounds are required. —*Lapp Process Equipment Div., Lapp Insulator Co., Inc., LeRoy, N. Y.*



Positive Action Pump Has Roller Vanes

The 4000 Series low volume pump has a scoop rotor fitted with roller type vanes. It is said that this design is well suited for pumping abrasive slurries.

The pump is constructed in either cast iron or Ni-Resist with Nylon or Hy-Car rubber rollers. Discharge rate is 7.5 gpm. at 100 psi. and 1,750 rpm. Operating pressure range is from 0 to 200 psi. Inlet and outlet ports are ¾ in. size. Net weight is 4.5 lb.—*Hypro Engineering, Inc., 404 N. Washington Ave., Minneapolis 1, Minn.*

See Louisville for
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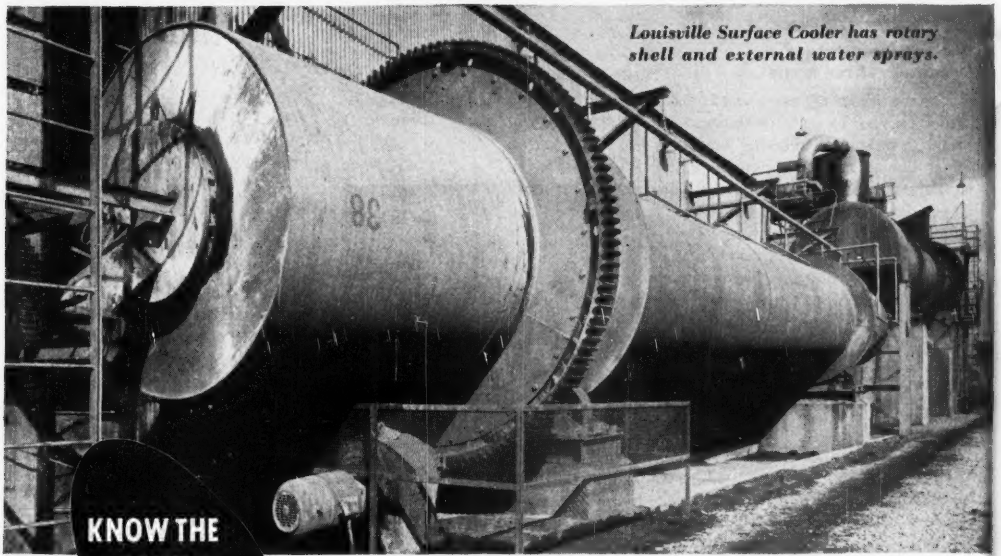
COOLING
ENGINEERING

Louisville Cooler does satisfactory job at low cost for nationally known chemical manufacturer . . .



Louisville Surface Cooler has rotary shell and external water sprays.

KNOW THE RESULTS
before you buy!

. . . cooling lumpy calcined material from 1800° Fahr. to 150° Fahr. for further processing. Gentle mechanical handling required to minimize decrepitation.

Each Louisville cooler is "*job-fitted*" to your special problem—to make your cooling operations effective—to assure dependability of performance that will make the cooler operation pay.

Call in a Louisville engineer for a complete cooling survey. Based on his experience he will recommend one of the three standard Louisville types, a modification, or an entirely new design. *The performance will be pre-determined.* You'll know the results before you buy . . . and the results *must* be better! Write for complete information today.

3 types of Louisville Coolers
- **Surface Cooler**
- **Water Tube Cooler**
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Other General American Equipment:
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Over 50 years of creative drying engineering

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In Canada: Canadian Locomotive Company, Ltd.
Kingston, Ontario

Paper Stock Pulper Combines Three Steps

A new piece of paper mill machinery is able to perform the operations of pulping, defibering and refining during one batch cycle. The working part of the unit consists of a circular, radially-serrated bedplate and an impeller with cutting knives which rotates against the bedplate face. This assembly is sidemounted at the bottom of a specially designed tub. Rotation of the impeller is provided by an externally coupled drive motor.

Pulp or waste paper stock is fed to the unit by the bale in amounts to give the proper consistency, which is normally from 5 to 6 percent. The rotating impeller, having a knife tip speed of about 3,000 fpm., pulps, defibers and refines the charge. By varying bedplate pressure against the rotating knives, variations in degree of refining can be obtained.

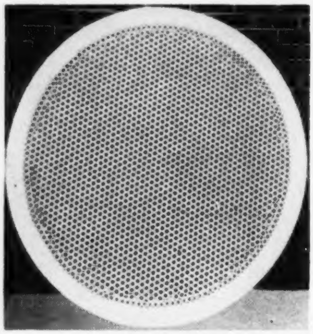
Among the many advantages claimed for this unit is the ability to do a thoroughly satisfactory job using cold water. In addition, the amount of undefibered rejects is negligible, except when handling waste paper with a high percentage of wet strength paper or cellophane.—*The Cowles Co., Inc., Cayuga, N. Y.*

Fabric Dyeing Machine Pressure Dyes Synthetics

Hailed as the first major change in fabric batch dyeing methods during the past five hundred years, the Barotor machine meets a need in the dyeing of synthetic fibres. Designed specifically for the pressure dyeing of Orlon acrylic fiber and Dacron polyester fiber, the machine is said to meet essentially every one of 14 characteristics of an ideal dyeing machine.

Representing the culmination of part of a long-range research problem on dyeing new synthetic fiber fabrics, the unit operates at 200 deg. F. with a pressure of 15 psi. The principal mechanical parts consist of a rotor and uniquely operating bars within a steel cylinder.

The unit was developed largely as a service to customers by the Du Pont Textile Research Division and licensing arrangements under pending patents are being made with several textile machinery firms. Textile dyers will be free to use the Barotor without royalty.—*E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.*



Tower Support Plate Is Stronger, More Open

A new type of ceramic support plate for packed columns is said to be much stronger than the perforated type support plate, while furnishing a higher percentage of open area.

The plate is made from a series of Raschig rings which are individually made and fired unglazed. The main outer ring is made up separately. Then by suitable assembly procedure and glazing, the small rings are mounted inside the outer ring and fired at normal firing temperature. This causes the outer ring to shrink around the smaller rings holding them together to form a very strong support plate with a maximum amount of free area.

Support plates are available in sizes ranging from 12 to 48-in. diameter, with larger sizes made to order.—*General Ceramics & Steatite Corp., Keasbey, N. J.*

Pressure Vessel Has Quick Opening Cover

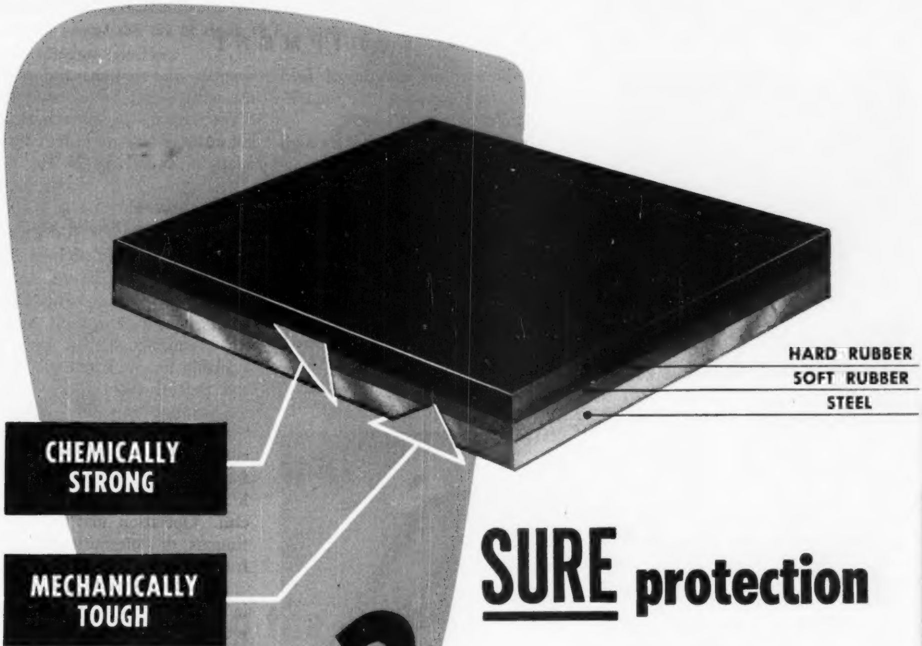
A quick opening cover which operates without the use of bolts and threads or multiple lugs is now available for use on pressure vessels. Designed to open and close in a matter of seconds, the cover is furnished in two types which provide a positive pressure seal. A minimum $\frac{1}{8}$-in. clearance at the locking surfaces eliminates sticking and jamming of material. Built-in safety devices prevent pressure build-up before the cover is completely closed and prevent cover removal when the vessel is under pressure.

Covers are available in diameters up to 42 in. for working pressures up to 600 lb. per sq. in. with temperatures not to exceed 300 deg. F. Where necessary, air-operated cover handling devices may be furnished. —*Clearing Process Cover Corp., 5620 W. 65th St., Chicago 38, Ill.*

Dewatering Screen Has Increased Open Area

The new Wedge-Slot screen for dewatering fine material is said to have at least double the open area of any other type dewatering screen. The wedge-shaped stainless steel bars making up the screen are smaller than have been previously used. Operations such as dewatering, drying, filtering, heavy media recovery, wet screening, and centrifuging are effectively handled by these units.

Slot spacings range from 0.004 to 0.06 in. Use of 1-in. rivet spacing rather than the more common $2\frac{3}{4}$-in. spacing is aimed at preventing distortion of slot width during screen operations.—*Hendrick Mfg. Co., Carbondale, Pa.*

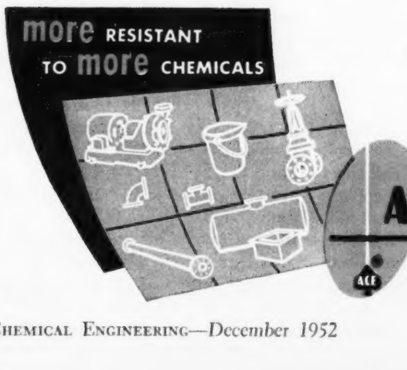


SURE protection ... 2 layers deep

The only surface exposed to corrosives in an ACE hard rubber lined tank or pipe is the top layer of smooth, age-proof hard rubber — resistant to almost every acid, alkali, and corrosive salt. Underneath is a layer of shock-resistant soft rubber that firmly bonds the hard rubber to the steel — a bond so strong the rubber can't be peeled off, and won't loosen or blister. There's extra protection at the seams, and in the well-rounded fillets and corners. Flanges, too, are rubber faced. It's details like these that make one tank last longer than another — that make ACE rubber-protected equipment the finest you can buy.

ACE PLASTICS | In addition to hard rubber and rubber-lined tanks, valves, pipe, molded parts, etc., we also offer corrosion-resistant equipment of many plastics such as Saran and Parian. We'll be glad to recommend the one *best* material for your job.

WRITE FOR BULLETINS



ACE rubber and plastic products

AMERICAN HARD RUBBER COMPANY
93 WORTH STREET • NEW YORK 13, N. Y.

Thermal Block Guards Solenoid Valves

Solenoid valves operating on refrigeration system suction lines and cold water lines are now offered with thermal block protection to eliminate coil short-circuiting from moisture condensation. This feature incorporated in the Marsh-Electrimatic solenoid valves, Types 60 and 65, is claimed to prevent the absorption of coil heat by the cold valve body.

The illustration shows a comparison between a valve with thermal block and one without, when mounted in suction line of a Freon 12 refrigeration system. The protected valve is seen to be free of frost build-up around the valve housing—*The Electrimatic Co., Skokie, Ill.*

Plastic Fan Is Tough, Durable

Ventilating fans for the chemical industries are now being fabricated of Lucoflex, a hard, unplasticized polyvinyl chloride material. These fans are said to be ideal for use when exposed to chemical fumes and are light weight and durable. Since the plastic does not contain any plasticizer, the aging qualities are excellent. Original toughness without cracking is retained over a long period of time.—*American Lucoflex, Inc., 767 Fifth Ave., New York, N. Y.*

Boiler-Burner Unit Offered As Package

Iron Firemen burners and Kewanee Scotch boilers are now available as completely integrated, carefully engineered combination units. Each unit is completely assembled with accessory equipment for oil, oil and gas, or gas firing. All refractories are integrally mounted at the factory thus reducing to a minimum the amount of field work required to place the combination boiler-burner in service.

This equipment is available for high pressure steam and water in sizes ranging from 52 to 304 hp., 125 and 150 lb. working pressure; also for low pressure 15 lb. steam or 30 lb. water in sizes from 1,808,000 to 8,400,000 Btu. Permissible fuels range from No. 6 fuel oil to high or low pressure gas or a combination of both. Forced draft operation eliminates the need for high stacks.—*Iron Fireman Manufacturing Co., Cleveland 11, Ohio.*

Automatic Torch Has Pistol Grip

All you do to start this torch is squeeze the trigger which, simultaneously, opens the acetylene valve and sparks the heavy-duty flint for ignition. The flame is shut off simply by releasing the trigger.

Some of the jobs that are handled by this acetylene air torch are loosening frozen nuts and bolts, setting anchor bolts, removing shrink-fit collars and bushings, heating branding stencils, safe-ending wire strand cable and rebabbitting bearings. Combustion tubes available in three sizes permit use of the torch for any air-acetylene job from heavy soldering or heating to the finest precision work.—*Velocity Power Tool Co., 7505 Thomas Blvd., Pittsburgh 8, Pa.*

Heat Exchanger Meets Sanitary Needs

A new multi-tube heat exchanger has been designed for sanitary applications. The unit is of the nested-tube type featuring the smooth finish required where equipment must meet sanitary codes. It is available in a number of variations and metals for use with water, brine, ammonia, and other refrigerants, or with steam and hot water.—*Niagara Filter Corp., 3080 Main St., Buffalo 14, N. Y.*

Dehumidifier Dries Storage Space Air

Fully automatic dehumidification of enclosed areas is said to be provided by the Desomatic DOR-800. Designed for long-term storage of Navy equipment, this unit is now available for industrial use in storage and packing rooms.

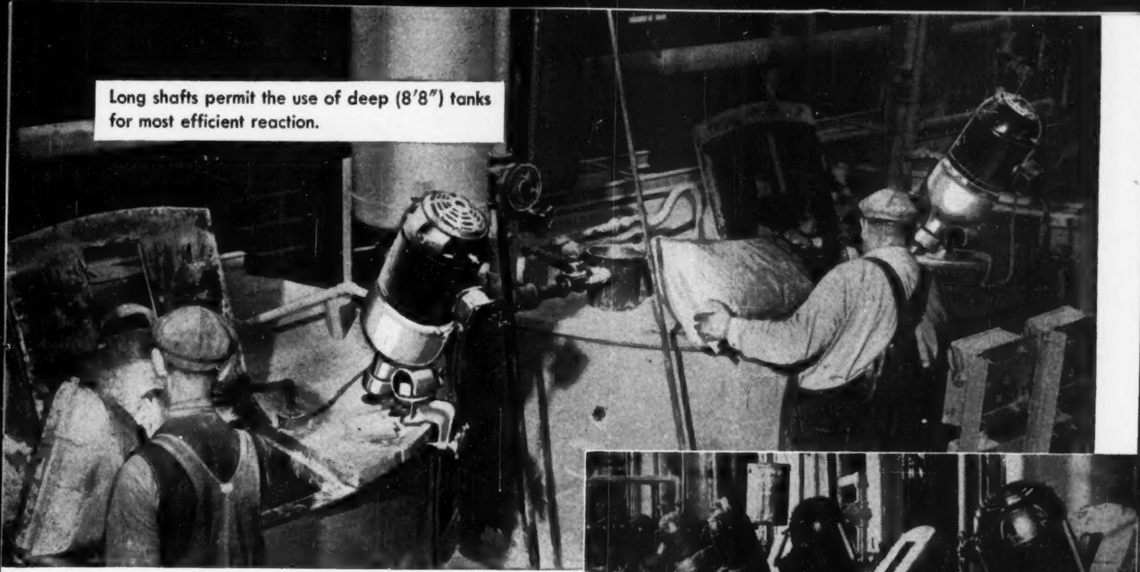
Operating on an automatically timed absorption and reactivation cycle, the unit has a rated capacity for removing 500 lb. of water per 24 hr. with a dry air volume of 1,500 cfm. Operation may be either continuous or intermittently controlled from a humidistat.

Any suitable desiccant may be used in the absorbent bed. Power requirement is 0.95 kwh. per lb. of water removed.—*Desomatic Products Div., Daly, Merritt & Sullivan, Inc., 1109 W. Broad St., Falls Church, Va.*

Line Burner Has New Refractory Design

The Radi-Heat gas burner has been designed for increased flexibility on industrial applications. A new simple refractory design is said to give maximum rate of heat transfer; complete fuel combustion with resulting economy; and minimum low cost maintenance. An extremely wide range of mixture ratios and pressures can be handled without backfire or loss of flame.

Units are available in capacities from 7,000 to 45,000 Btu. per hr. Burners can be made up to any desired length merely by mounting the sectional burners in a common mani-



Long shafts permit the use of deep (8′8″) tanks for most efficient reaction.

These *Lightnin Mixers* Have Been Doing the Job Right for Over 10 Years!

"Our LIGHTNIN *Mixers were installed in 1941. They've been doing an excellent job ever since,"* says Dr. J. M. Perri, plant superintendent, National Foam System, Inc., West Chester, Pa. National Foam uses a battery of eight 1-HP LIGHTNIN Mixers in the manufacture of its AER-O-FOAM fire-fighting compound.

Dr. Perri goes on to say, "LIGHTNIN Mixers have proved easy to install. They have been practically free of mechanical troubles, and their long shafts permit us to use deep reaction tanks for most efficient processing."

If your requirements call for fluid agitation, consult MIXCO. *We have the research and engineering facilities to accurately predict processing results—and we'll absolutely guarantee those results with* LIGHTNIN *Mixers. Write us about your requirements.*

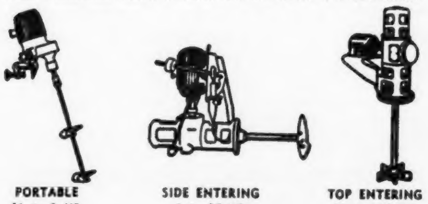
LIGHTNIN case history

OPERATION:	Reaction of protein product (soya) with lime and water for hydration.
TANK:	3300 gal. stainless steel tank. 96" diameter x 104" straight side height, open top and dish bottom.
HEATING:	Two steam coils to heat batch to 200°F.
REACTION TIME:	One hour (approx.)
MIXING:	One 1-HP LIGHTNIN Portable Mixer.
MIXER PERFORMANCE:	HIGHLY SATISFACTORY. User has obtained excellent results from these mixers for more than 10 years.

MIXCO

fluid mixing specialists

EVERY *LIGHTNIN* MIXER IS GUARANTEED TO DO THE JOB *RIGHT*



PORTABLE ⅓ to 3 HP — SIDE ENTERING 1 to 25 HP — TOP ENTERING ¼ to 500 HP

MIXING EQUIPMENT Co., Inc.

128 Mt. Read Blvd., Rochester 11, N. Y.

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Please send me the bulletins checked:

- ☐ B-102 Top Entering Mixers (turbine and paddle types)
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- ☐ B-103 Top Entering Mixers (propeller type)
- ☐ B-75 Portable Mixers (electric and air driven)
- ☐ B-104 Side Entering Mixers
- ☐ DH-50 Laboratory Mixers

Name..

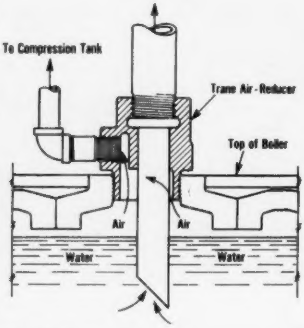
Title..

Company..

Address..

City........................Zone....State..........

fold. Adjacent threaded parts of the burners are of dissimilar metals to overcome seizing after continuous operation at high temperature.—*Burdett Mfg. Co., 3433 W. Madison St., Chicago 24, Ill.*



Air Reducer Purges Hot Water System

This new hot-water heating specialty is easily installed for removing air at the boiler.

As you can see from above drawing the air-reducer is in effect a pipe within a pipe. The brass inner tube extends hot water system's supply main below water surface in boiler, thus preventing air from entering piping and heating units. Air collecting at top of boiler is bled off to compression tank through outer casting.

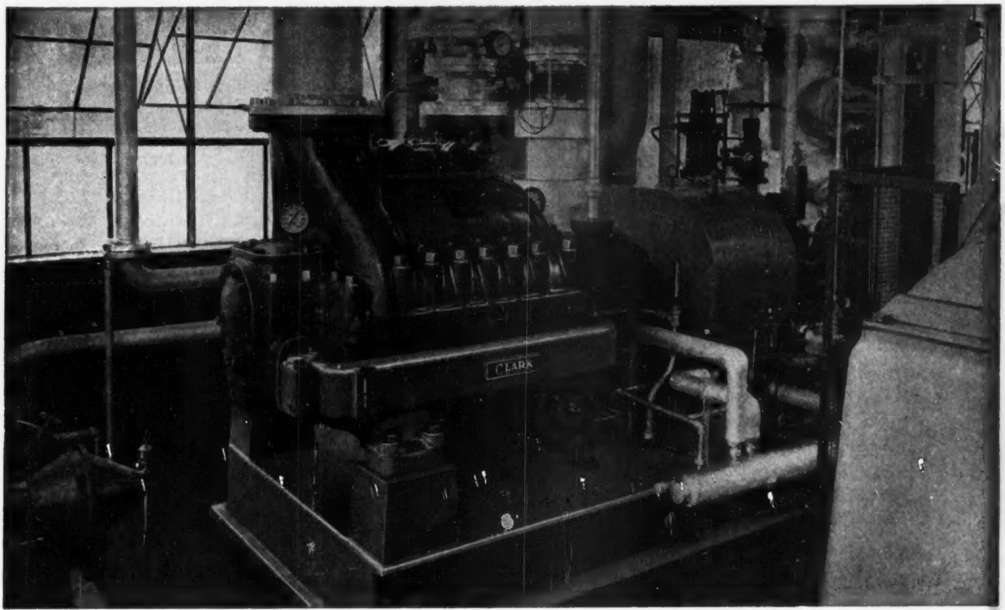
Air reducer is made for boiler and main sizes ranging from 1 x 1½ in. to 3 x 4 in.—*The Trane Co., Lacrosse, Wis.*

Infrared Heater Operates Economically

The Merco infrared heater has the physical appearance of an ordinary fluorescent lighting tube. The infrared element is mounted inside a Pyrex glass tube which has a high coefficient of radiant heat transmission, plus a high thermal shock resistance. A relatively low operating temperature gives the tube extended life. A continuous heating element running the length of the tube provides even over-all distribution of heat, eliminating so-called hot spots found in other types of heaters. The internal tube chamber is at atmospheric pressure, reducing explosion and fire hazards. Operating cost is said to be very low.—*Corona Mfg. Co., 5210 San Fernando Road, Glendale 3, Calif.*

for producing life-saving Bacitracin

Commercial Solvents simplifies installation with Clark single case centrifugal compressor



Clark No. 2 Standard Multi-Stage Centrifugal Compressor, non-condensing steam turbine driven, and mounted on a steel base with the turbine for permanent alignment.

● When Commercial Solvents Corp. of Terre Haute, Indiana decided to expand facilities for the production of the new antibiotic, Bacitracin, the problem was to obtain a large supply of air that could be easily sterilized. Compressor selection would be determined by the following factors:

Air was to be oil-free.
Steam was to be the source of power.
Available floor space was 7 x 11 feet including aisles!
650 horsepower was required.

An analysis proved a centrifugal compressor would be the correct answer, economically and process-wise if the available space was sufficient. Only Clark could handle the problem because only a Clark compressor could *economically* accommodate the pressure rise in one compressor case.

The reason: Only Clark could supply water cooled interstage diaphragms between impellers, thereby reducing costs tremendously.

Clark solved this problem as it can solve your problem, the simplest way, the least costly way, the best way.

CLARK BROS. CO.
DIVISION OF DRESSER OPERATIONS, INC.
OLEAN, N. Y.
Offices in Principal Cities Throughout the World

CLARK

multi-stage centrifugal
COMPRESSORS

GAS-ENGINE-DRIVEN • STEAM-ENGINE-DRIVEN • MOTOR-DRIVEN • CENTRIFUGAL

Plastic Tank Stops Corrosion

Now used for crude oil storage this plastic tank is corrosion resistant, strong, light and dimensionally stable. Paint maintenance is eliminated. Gas loss is cut.

Many of your liquid storage problems face removal from your active calendar if the promise shown by a new storage tank continues to grow. Through perfection of design details and production techniques the manufacturer has made available a tank constructed of Fiberglas-reinforced Laminac polyester resin. The inherent properties of this material are said to offer the user greater economy than competitive construction materials.

Heading the list of advantages provided by this tank is its corrosion resistance. In crude oil storage the tank is impervious to damage by hydrogen sulphide gases, salt water, and hydrolytic action. Other tests have previously established Laminac's resistance to various acids, alkalies, chemicals and solvents.

Vapor loss from the tank is only a fraction of that suffered from conventional tanks. The reinforced plastic has such a low thermal conductivity that the tank contents are actually insulated from sun heat which is responsible for the loss from oil storage of hundreds of dollars worth of fuel gas per year. Also bolted sections of the tank do not contract or expand under varying temperature extremes so that section joints stay tight.

The light weight of the tanks, achieved without sacrifice of strength, saves on shipping costs and eases the work of handling and erection. The contrast is shown by a total weight of 1,600 lb. for a plastic 500-bbl. tank as compared with 7,940 lb. for a steel counterpart.

Maintenance requirements are nil. Calcium carbonate filler in the resin gives the surface a white appearance which is permanent. Thus painting is never required.

Tank sides are formed by curved staves measuring 8 by 10 ft. Pie-slice segments make up the deck or tank top and the bottom.

Down one side of each stave and along one straight edge of each deck and bottom segment runs a channel. These channels are located on the side that faces inward after assembly. Bolts spaced on 2-in. centers are molded into the channels so that the shanks protrude through to the outside surface. A layer of plastic over the bolt heads in the channels completely protects the bolt metal from corrosion. Channel edges are offset slightly and faced on the outside with neoprene gaskets to assure a snug fit with adjacent edge strips.

Not only do the channels serve as fastening mounts but they also provide strength reinforcement eliminating the need for inside deck supports. Added strength is furnished at the bolt lines by molding the material to 0.165 in. thickness as compared to 0.125 in. elsewhere.

Presently the tanks are being built in 250 and 500-bbl. sizes. Future plans call for the production of units up to 3,000 barrel capacity. All construction is in accordance with API Bolted Tank specification. Initial cost is competitive with aluminum and 20 percent higher than galvanized steel.—*Murdock Tank & Mfg. Co., 3418 South Santa Fe St., Tulsa, Okla.*

Slip-On Fittings Link Structural Piping

Construction costs for permanent or temporary pipe structures are said to be greatly decreased by the use of Nu-Rail slip-on fittings. Such savings are possible because pipe cutting, threading and welding are eliminated. Five basic fittings plus a floor and wall flange and a drive fit end cap are available. These aluminum alloy fittings are furnished in sizes to fit standard pipes from ¾ to 2 in. Fittings are locked in place by two knurled vibration-proof cup-point set screws.—*The Hollander Mfg. Co., 3841 Spring Grove Ave., Cincinnati 23, Ohio.*

Exchangers, Plug Valves Are Plastic Protected

Baked phenolic coatings are finding increasing use for combatting corrosion and product contamination. They are now being successfully applied to heat exchanger tubing, plug valves and centrifugal pumps.

Coatings are generally 0.004 to 0.005 in. thick. On close tolerances as encountered in pumps and valves the metal must be undercut to allow for the coating thickness.

Typical heat exchanger applications are on the water side of condensers

using corrosive brackish water as coolant, sulphuric acid coolers and heaters in excess of 200 deg. F, and the exterior coating of tubes to prevent adhesion of products, such as latex. The smallest diameter heat exchanger tube that can be internally coated is ¾ in., 16 gage. Upper temperature limit is 225 deg. F.

Use of this type coating is not recommended in solutions with a pH greater than 10 or where furfural or greater than 98 percent sulphuric acid are handled. One other service not suited to these coatings is the handling of slurries through pumps or valves.—*Plastic Applicators, Inc.*, 9110 *Katy Rd., Houston, Texas.*

New Press Extrudes Tubing

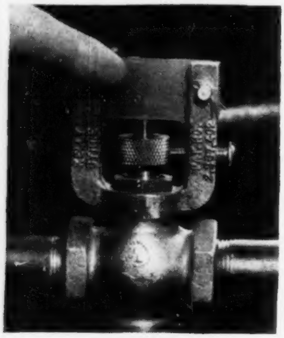
New equipment at the Babcock & Wilcox Co. makes a large number of unpierceable metals available as tubing for the first time. Based on the Ugine-Sejournet hot extrusion process, this new equipment produces tubing by an extrusion process instead of by conventional piercing and rolling.

Using this equipment, a white hot billet of selected metal 28 in. long by 8 in. in diameter can be extruded into a 60-ft. tube 2 in. in diameter in less than 5 sec. A die and mandrel form an annular aperture through which metal is forced to make tube. Removal of mandrel permits extrusion of solid bars.

With this equipment, metal such as molybdenum and its alloys, titanium and certain of the stainless steels can be extruded into useful shapes.—*Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa.*

Stainless Steel Strip Rolled to Very Thin Gage

The available forms of stainless steel strip have now been extended down to thicknesses of 0.0005 in. with tolerances of ± 0.0001 in. Various stainless steels produced in this thin gage are available up to 8 in. wide in any quantity from 1 lb. to thousands of pounds. Equipment used in manufacturing this strip includes precision two-high, four-high, and Sendzimir rolling mills; precision gang slitters; and continuous annealing lines.—*Industrial Div., American Silver Co.*, 36-07 *Prince St., Flushing* 54, *N. Y.*



Fusible Plastic Link Actuates Gas Shut-Off

In case of fire which may melt a gas line meter you can assure positive gas shut-off with the Kelley-Byrne safety valve. The valve mounted in the gas line ahead of the gas meter has a fusible plastic link which distorts at approximately 165 deg. F., forcing a tension spring to close the valve.

The plastic link is made of Geon 404, a rigid non-plasticized polyvinyl chloride resin. This material was the only one of many tested that came through a months long test at 125° F without creep or deformation. The valve has the approval of the Underwriters' Laboratories.—*Kelly Safety Device Co., Cleveland, Ohio.*

Oil Resistant Gloves Have Slip-Proof Palms

A glove with vinyl resin outer surface is said to offer effective gripping action on slippery objects. Numerous inert particles of material sprinkled through the vinyl coating provide the positive grip.

These gloves are said to be especially suited for work in oils, greases and lubricants. In addition, there is resistance to most chemicals, acids and alkalies. High abrasion resistance is claimed, along with flexibility at low temperature.—*Plasticote Glove Co., Inc., 102 East Walnut St., Milwaukee 12, Wis.*

Plastic Goggle Feels Light, Comfortable

Model 440 and 441 Eye-Savers are goggles with extra-wide plastic lens and soft plastic frames. An improved nosebridge and frame design are said to make the goggles feel light and comfortable even after long hours of wear. The goggles are large enough to fit over the largest metal or horn rimmed glasses.

For maximum impact resistance the Eye-Savers are fitted with methyl methacrylate lens while acetate lens suffice for average impact resistance. Lens are available in clear, light, medium or dark green colors.—*Watchemoket Optical Co., Inc., Dept. N63, 232 W. Exchange St., Providence, R. I.*

Central Safety Station Is Easy to Find

Men needing emergency safety equipment are said to have no difficulty spotting this large central station. The combination of a safety-green background and the white and red equipment boxes make such a station clearly visible from a distance.

A central installation of this type in each plant section serves to replace scattered safety equipment spotted at many different hard-to-remember locations. Large signs and lettering identify the station and each equipment box, thus inexperienced help can quickly locate safety gear in an emergency.—*Mine Safety Appliances Co., Pittsburgh, Pa.*

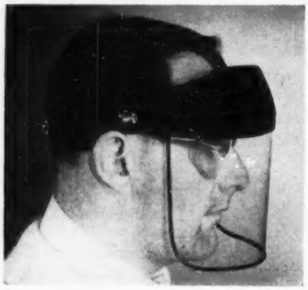
The Zipper Becomes A Gripper

Certainly the latest use for man's good friend, the zipper, was never envisioned by its inventor. For now this indispensable gadget is being molded into the palms of work gloves to give a long-wearing gripping surface. Closed zippers are anchored to the palms and fingers of Armor Grip work gloves by a synthetic rubber band. These gloves are said to give the worker an added safety factor against impact, cutting and abrasive wear.—*Surety Rubber Co., Carrollton, Ohio.*

Solvent Transfer Pump Has Flame Arrestors

Built-in flame arrestors in a new hand transfer pump provide effective protection against explosions and fire hazards when transferring hazardous liquids from receiving drums to smaller containers. The arrestors are placed at the spout, above the bung adaptor and at the strainer inlet within the drum. In addition the pump provides for vent and pressure relief through protected openings.

Pumping rate is 5 gpm. The construction is aluminum alloy with a brass telescopic tube which permits pumping from either the side or end opening of 30 or 55 gal. drums. The pump is tested and approved by Underwriters' Laboratories and Associated Factory Mutual Fire Insurance Companies.—*Protectoseal Co., 1920 So. Western Ave., Chicago 8, Ill.*



Face Shield Fits Over Glasses

A face shield with sufficient clearance to be worn over glasses and industrial goggles has recently been put on the market. The greater clearance also provides better ventilation. Identified as Model 301, the shield is glove-buttoned to a form-fitting headgear which is readily adjusted to any shape or head size.

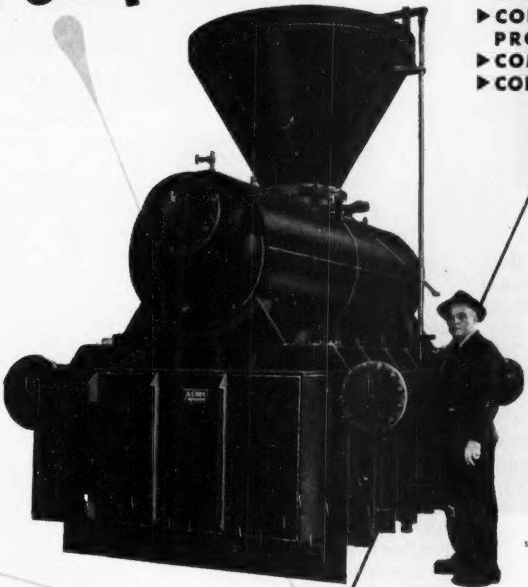
Three types of shields are interchangeable with one headgear—plastic shield for general utility (illustrated), fiber front with glass holder for gas welding, and screen window for heat-treating and cyaniding.—*Boyer-Campbell Co., 6540 S. Antoine St., Detroit 2, Mich.*

save sulphur!

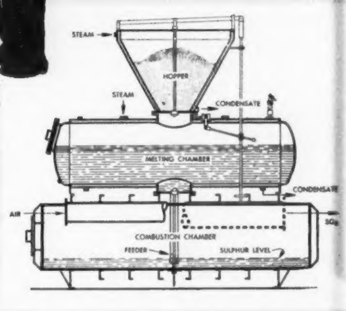
■ ACME SULPHUR BURNERS PROMOTE MORE ECONOMICAL USE OF SULPHUR

thru

- ▶ CONTROLLED, UNIFORM PRODUCTION OF SO_2
- ▶ COMPLETE COMBUSTION
- ▶ CONTINUOUS OPERATION



The Acme patented Sulphur Burner is especially constructed to operate at a controlled rate sufficient to burn off the accumulation of carbonaceous scum that retards the operation of an ordinary sulphur burner. In an ordinary burner, the addition of a fresh charge of sulphur to the burning surface disrupts the burning rate for several hours. The Acme Sulphur Burner has a special feeding device that feeds melted sulphur to the burner in a manner that does not disturb the burning surface, at the same time maintaining a constant level of burning sulphur. Whether operated at atmospheric pressure, high compression, or under vacuum, the Acme Sulphur Burner attains maximum production of SO_2 from available supplies of sulphur.



OPERATING PROCEDURE

Solid sulphur is charged into the hopper of the melting chamber, around which live steam is introduced at about 25 pounds gauge pressure (if steam is not available, an electric heating element is supplied). The melted sulphur is fed to the combustion chamber by means of the feeder, which automatically maintains the correct level. Compressed air, or air furnished by a blower, is used for combustion. The quantity of air supplied regulates the concentration of SO_2 produced.

Since the introduction of the feed is below the surface, the burning area is never disturbed. This, together with the unchanging level of molten burning surface, and a controlled air supply, guarantee a constant burning rate and thereby a uniform production of SO_2.

ACME Processing Equipment

ACME COPPERSMITHING & MACHINE CO., ORELAND, PA.

Dictating Machine Is Compact, Portable

Here is a dictating machine that will be warmly welcomed by all engineers who must write reports while traveling. Weighing only 11 lb. and measuring 11⅞ x 9$\frac{7}{16}$ x 2$\frac{7}{16}$ in. this machine easily fits into a brief case for carrying.

Recordings are made on 7 in. vinylite plastic disks which have a capacity for 30 min. dictation. Power supply can be 115-v., 60 cycle a.c. or if required converters are available for other currents and automobile use.—*Thomas A. Edison Inc., West Orange, N. J.*

Electronic Computer Solves Differentials

The new L3 GEDA linear electronic differential analyzer can compute the solution of 12th-order differential equations involving 10 initial conditions. A switch may be set to stop and hold the problem solution when any variable reaches a pre-set level, when two variables become equal, or if any of the computing elements fails. One machine can perform the work of 50 to 500 men depending upon the type of problem. Also accuracy is greatly increased.—*Goodyear Aircraft Corp., Dept. 65A, Akron 15, Ohio.*

Midget Packing Gland Seals Thermocouple Entry

Model MPG midget packing gland is designed as a standard seal for the entry of small dial-type thermometers, thermocouple wells, pitot tubes, static pressure tubes, round rods or tubes or even insulated electric lines. The gland is machined from Type 303 stainless steel cold-drawn bar stock and has a length of only 1⅛ in. Neoprene packing compressed by a gland follower provides the positive seal.

These glands are available from stock for tube diameters of $\frac{3}{32}$, ⅛ and $\frac{3}{16}$ in. The threaded connection is standard ⅛ in. I.P.S.—*Conax Corp., 4515 Main St., Buffalo 21, New York.*

Electromagnetic Meter Gives Flow Rate

Electromagnetic induction provides precise measurement of volumetric liquid flow rate by the Flowtron meter. The instrument can be used on any liquid that has a conductivity equal to or better than water. Sensitivity is equally good over the entire flow range for which a particular instrument is calibrated. Readings are accurate within ±1 percent of full scale and are unaffected by changes in liquid viscosity, density, turbulence and temperature, it is said.

The heart of the Flowtron is a small detector unit which contains a flow tube held in the gap of an electromagnet. Liquid passing through the tube induces a voltage which is proportional to the linear velocity of the stream. Because the voltage induced is a linear function of flow rate, it is readily and accurately indicated or recorded on a linear scale. The flow indicator is connected by cables to a recorder which amplifies the voltage signal by means of special circuit. A motor driven pointer indicates the flow reading, which is continuously charted by a recording pen. The flow detector has no moving parts and presents no restriction to the liquid flow. The detector and the recorder may be located remotely from each other. An automatic control unit may be added to the recorder unit to provide actuation for various types of control systems.—*Vitro Corp. of America, 233 Broadway, New York 7, N. Y. N. Y.*

Scanning System Makes Printed Record

A new rapid scanning system known as the Telescan makes printed records of process data directly from the primary information. Readings are presented in numerical form tabulated for convenient use on a single page. The system reads voltage, current, power, temperature, flow, or anything else that can be translated into electrical indications with a suitable transducer. Telescan also sets up an alarm for any abnormal condition.—*Tigerman Engineering Co., 4332 Northwestern Ave., Chicago 18, Ill.*

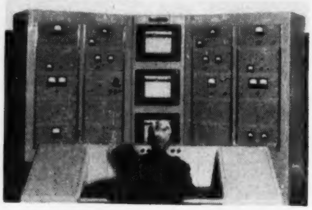
Heavy DC Current Measured By Reactor

Safe measurement of d.c. current up to 120,000 amp. is possible with various models of a new G. E. current-measuring reactor. The main feature of the new device is that it isolates the control leads from the current being measured, in contrast to shunt measurement where the leads are at the d.c. potential.

The new device slips in place over the d.c. bus and does not require that the bus be broken or that bolted connections be made at the point of measurement. Low a.c. voltage energizes the instrument leads reducing shock hazard materially at the control panel.

In operation, two toroidal-wound cores in the reactor are saturated by the direct current in the bus. When

the a.c. current is applied it alternately desaturates the cores of the two coils on consecutive half cycles. The point of desaturation limits the a.c. current. The value of this a.c. current, indicated on an ammeter, is proportional to the intensity of the d.c. saturation, thus measuring the d.c. current.—*General Electric Co., Schenectady 5, N. Y.*



Nuclear Reactor Controls Now Available

For the first time, complete instrumentation for controlling nuclear reactors by free enterprise has been announced. At the same time, services and counsel are available in the installation of small experimental research nuclear reactors.

The instruments which are made to Oak Ridge National Laboratory specifications include a period amplifier, log-count rate meter, sigma amplifier, power supply for compensated ionization chamber, magnet amplifier, log n amplifier, Oak Ridge A1 linear amplifier, micromicroammeter period recorder, log n recorder, parallel circular plate chamber, and compensated ionization chamber.—*Radiation Counter Laboratories, Inc., 5122 West Grove St., Skokie, Ill.*

Radioactivated Gage Measures Process Variables

Process conditions which vary as a function of the density of materials being processed can now be measured easily despite the existence of high pressure or temperature, corrosive or erosive conditions. The tool for this job is the Ohmart Density Gage, a null system of measurement based on radioactivity.

This new instrument is a modification of the Ohmart cell which, on exposure to radioactivity, produces an electric current proportional to the amount of radiation received by the cell. If two cells, identical except for polarity, are used for gaging purposes

their combined output will be zero when exposed to the same flux density. However, any change in the amount of radiation received by one cell with respect to the other will cause a consequent change in the first cell's output current. This change is a function of the condition that caused the initial change in radiation and as such is measurable.

Use of the Ohmart Density Gage for measuring process variables merely requires that the gage cells and a suitable radioactive source be properly positioned with respect to the vessel or operation being measured. Among the many applications possible are determination of interface and liquid level for corrosive chemicals, measurement of coating thickness during the continuous coating of variable base materials, continuous comparison of the density of a moving web and a standard sample, and continuous compensation for variation in particle size during the batching of granular materials. Also the gage can be used for gas analysis to check variations in one component of a binary mixture.—*The Ohmart Corp., 2347 Ferguson Rd., Cincinnati 38, Ohio.*

pH Recorder-Controller Operates Under Pressure

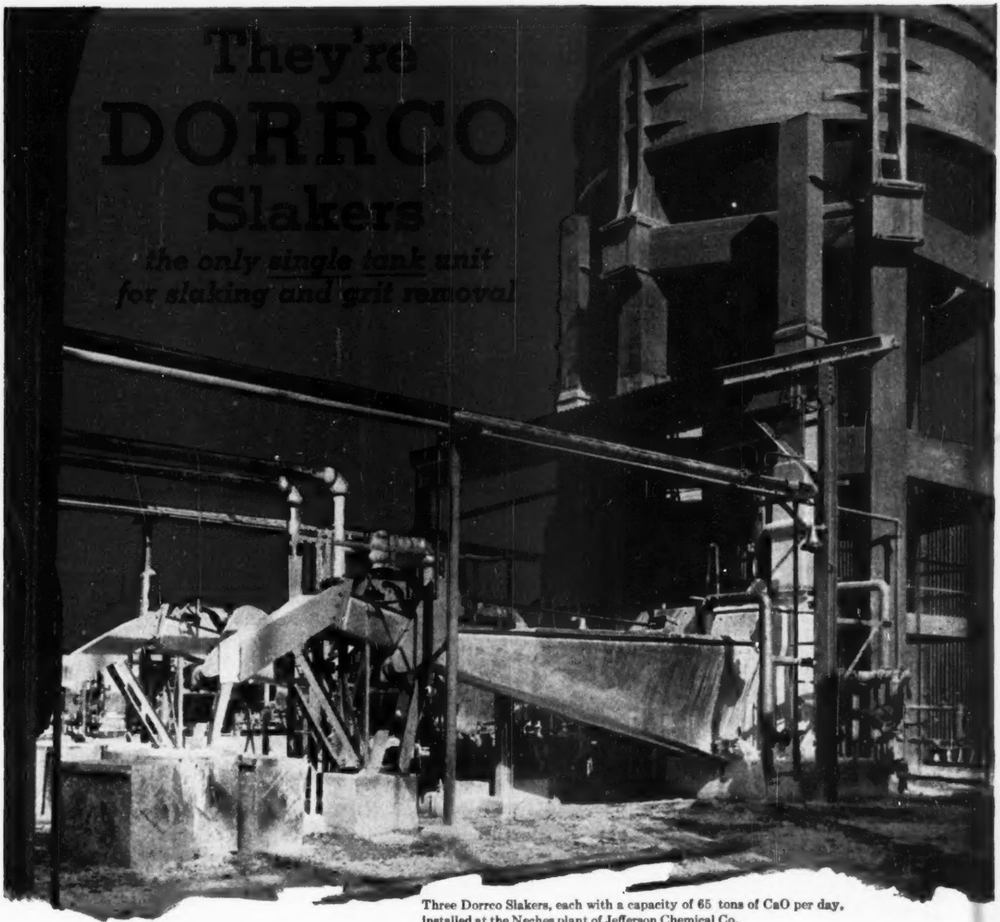
A recent English development in pH measurement and control is said to offer increased reliability and accuracy for process control. Among the advantages claimed for the Kent Universal glass electrode recorder are decreased maintenance and the ability of the electrodes to operate in pressure systems.

Continuous, accurate operation for periods of several months without the need for addition of potassium chloride solution or any other maintenance represents a major advance. Previous salt bridge designs have made it impossible to measure accurately the pH value of liquids under pressure. Now with this new instrument, measurement accuracy is unimpaired under pressures up to 75 psi.

The electrode assembly can be furnished for partial or complete immersion in a tank or for placement in a flow system. Accessories for this second type of assembly permit measurements to be taken under pressure. —*George Kent Ltd., Luton, Bedfordshire, England.*

They're DORRCO Slakers

the only single tank unit for slaking and grit removal



Three Dorrco Slakers, each with a capacity of 65 tons of CaO per day, installed at the Neches plant of Jefferson Chemical Co.

To simplify your slaking operations, get to know the Dorrco Slaker. It is a neat and compact unit that provides safe and clean operation. There is a size to meet every need . . . from 5 to 200 tons of CaO per day.

Here is a quick look at some of the advantages the modern Dorrco Slaker gives you —

Large unit capacity because mechanism and tank design produces rapid hydration.

Quick installation at low cost... your Dorrco Slaker is shipped almost completely assembled, requires no field welding, no costly piping installation.

Low maintenance costs... because all bearings are above solution and 1" thick white iron liners in the slaking compartment are designed for quick and inexpensive replacement.

Bulletin No. 7281 gives you more information about the Dorrco Slaker, its compactness, its simplicity and its durability. A copy of Bulletin No. 7281 is yours for the asking. Write for your copy today. THE DORR COMPANY, BARRY PLACE, STAMFORD, CONN.

Better tools TODAY to meet tomorrow's demand

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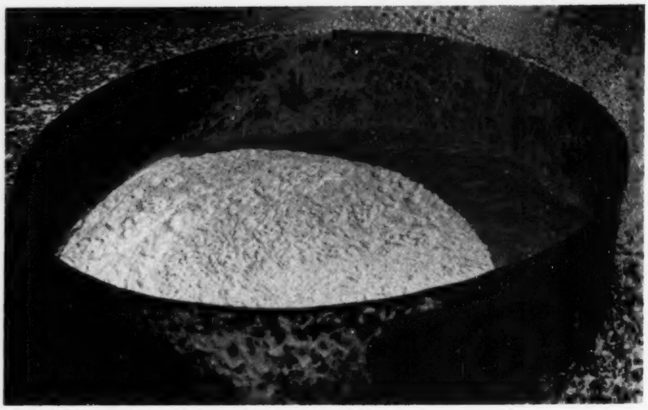
Product News **Edited by Frances Arne**

BLAZING isopropyl alcohol . . .



EXTINGUISHED in ten seconds by new air foam.

Foam Chokes Off Alcohol Fires

Specifically aimed at fires in water soluble solvents, protein-base foam is effective against all flammable-liquid fires.

A newly-developed fire-fighting foam is expected to have wide application where there are mixed oil and alcohol hazards. These are increasingly present as more and more oil refineries get into the industrial chemicals field.

The foam is said to be the most stable ever known—many times more stable than any air or chemical foam in use. Its useful life is almost 50 times greater than that of other foams regarded as stable. It is almost completely resistant to breakdown by any of the known water soluble solvents.

Equally effective in fresh or salt water, it is intended to be used at a concentration of 6 percent. While half the water drains from what is considered a good foam in 10 minutes, the half-way drainage time for the new foam is 12 hours.

Made by Pyrene Mfg. Co. the compound is a dark brown liquid with a specific gravity of 1.2. It is of the low-expansion, eight-to-one type. Any equipment designed for low expansion compounds will produce a satisfactory foam.

The foam has passed all tests required by Underwriters' Laboratories. Approval is expected for use on fires in all water soluble solvents, oils and other hydrocarbons.

It is not recommended to use this foam against hydrocarbon fires in preference to compounds like Pyrene's 3 percent low expansion type unless there is an alcohol or similar risk present. It would be uneconomical when compared with the latter and there are certain limitations as to its use. The compound precipitates immediately on dilution with water and separates out fairly rapidly and the solution is only effective during the first minute or two after dilution. Consequently, it is not suitable for use in systems involving premixed solutions nor where there is a long time lag between pumping the foam compound into the water stream and making the foam.—*Pyrene Mfg. Co., 560 Belmont Ave., Newark 8, N. J.*

Rosin Type Rubber

A new type of GR-S promises 30 to 50 percent more abrasion resistance than standard cold rubber.

Pilot plant quantities of a new rosin type rubber have been produced at the Naugatuck, Conn., synthetic rubber plant operated by U. S. Rubber for the Reconstruction Finance Corp.

Laboratory tests show that the new synthetic gives 30 to 50 percent more abrasion resistance than standard cold

IN BRIEF—A capsulated listing of this month's newsworthy products

rubber. It also has good resistance to heat, cracking caused by rapid flexing and the deteriorating effects of aging in air.

The new rubber is made possible by the addition of rosin chemicals, by-products of turpentine manufacture, to an extra tough cold type of GR-S synthetic rubber.

The chemicals are added to the rubber when it is in the latex or liquid form. Carbon black, the principal reinforcing agent for rubber, may also be added at the same time.

The rosin chemicals make the rubber easier to fabricate into products and improve its end product qualities. —*U. S. Rubber Co., Rockefeller Center, New York 20, N. Y.*

Di-isobutyl Phthalate

Replacement for dibutyl phthalate in cellulose nitrate formulations.

Cellulose nitrate formulations containing di-isobutyl phthalate are said to have better low-temperature characteristics than those containing dibutyl phthalate. What's more di-isobutyl sells for about a cent a pound less than its better known relative.

Properties of formulations using either dibutyl or di-isobutyl are about identical. The two compounds themselves have many similar properties: color, specific gravity, acidity as phthalic acid.

Tennessee Eastman which is offering di-isobutyl phthalate commercially for the first time has an assured supply of raw material isobutyl alcohol. It has recently opened production facilities for the latter in Longview, Tex.—*Tennessee Eastman Co., Kingsport, Tenn.*

Liquid Polymer

For use in protective coatings, binders, sealing.

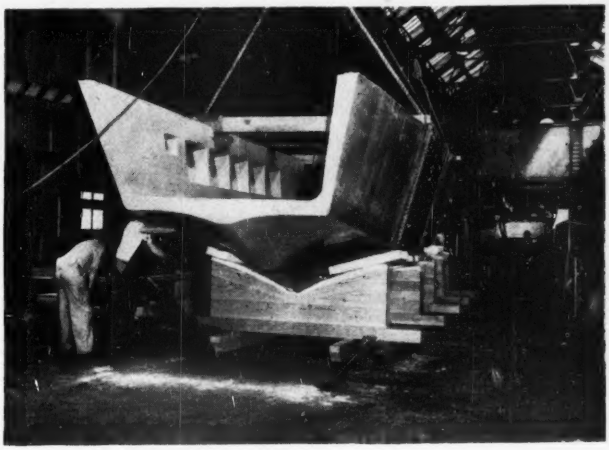
Thiokol LP-2 is a viscous liquid said to convert to a tough resilient, solvent-resistant rubber at room temperature. In the rubber state, it remains flexible to −65 deg. F. and has a maximum service temperature of 250 deg. F.

LP-2 films can be applied on metal, glass cloth, fabric, paper and other materials. It can be compounded to be cold setting or heat sensitive and can be applied out of solvent solution at low viscosity and high solids. The rubber-like films so produced resist atmospheric aging, solvents and oils.

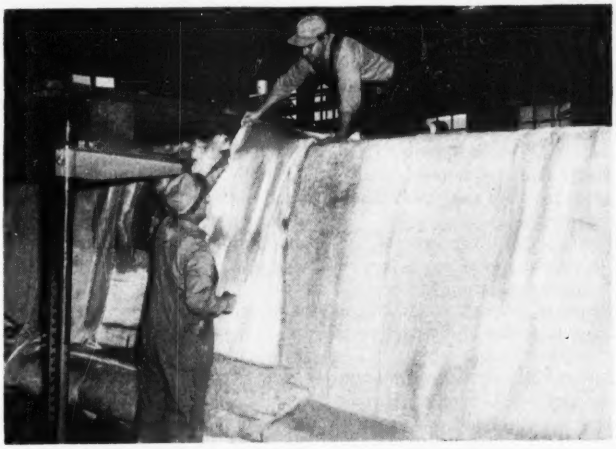
Aggregates such as cork, wood flour and asbestos can be bound together with a relatively low volume loading of LP-2. Since LP-2 is non-hygroscopic, good dimensional stability is obtained over a broad humidity range.

The resultant compounds are said to display exceptionally good resistance to oils, fuels, solvents and atmospheric oxidation.

The compound will flow into openings or irregularities forming positive, permanent seals which will not harden or crack at low temperatures or flow at elevated temperatures.—*Thiokol Corp., Trenton 7, N. J.*



LANDING CRAFT MADE OF PLASTIC . . .



REINFORCED BY GLASS MATTING

The Navy is well pleased with the five LCVPs they have recently produced from polyester plastic reinforced with glass fiber. They find their molded product is stronger and longer lived than the wooden ones which they have always used in the past. Plastic boats will not splinter from gunfire and they neither dry out nor corrode. And they will never need paint. To make the boats, Navy men inject resin into a mold containing glass cloth, glass matting and Styrofoam blocks. Puget Sound Naval Shipyard, Bremerton, Wash.

GELLED, they can be fabricated at low heats and pressures.

FOAMED, they excel rubber in chemical and flame resistance.

Vinyl Resins Gelled or Foamed

Two easy economical processing techniques offer two new product outlets for vinyl resin. No costly equipment is needed to make or fabricate products.

Two unique and unlike products based on vinyl resin dispersions have been introduced in recent months.

- Plastigel, a putty-like material which can be processed at room temperatures with low pressures, yet retains its shape to the smallest detail. It should find application in tubing and sheeting, cloth and paper coatings and dip coatings.
- Foamed plastisol, a material similar to cellular rubber but with more flame, resistance, chemical resistance and ease of fabrication. Its cost is comparable to that of foam rubber in the fabricated form.

Each of these owes its existence to a new economical technique for processing plastisols—fluid dispersions of vinyl resin in plasticizer to which desired quantities of pigments, fillers and stabilizers have been added.

▸Plastisols Gelled—Gelling agents make the difference between plastisols and plastigels both in preparation and in properties. When making plastigels, proceed as in making plastisols—mix resin, plastizers, fillers, colorants and stabilizers to form a paste, refine by grinding on a 3-roll paint mill. Then comes one extra step—the conversion of the paste to plastigel by addition of gelling agent in a dough or pony mixer.

Effective gelling agents are metallic soaps such as aluminum stearate, silica aerogels and organophilic bentonites. Flow properties of plastigels vary with their content of gelling agent. This concentration, dictated by fabrication requirements, generally falls in the range of 2 to 10 percent of the weight of the plastisol.

The plastigel technique was developed by Union Carbide and Carbon's fellowship at Mellon Institute. Bakelite Corp., a Carbide subsidiary, supplies Vinylite resins, plastigel raw material.

Advantages such as lower machine and mold costs are made possible by the low pressure required to fabricate plastigels. Tubing or wire coatings can be extruded under low pressures in the plastigel state and then cured by passage through an oven or in a hot liquid bath.

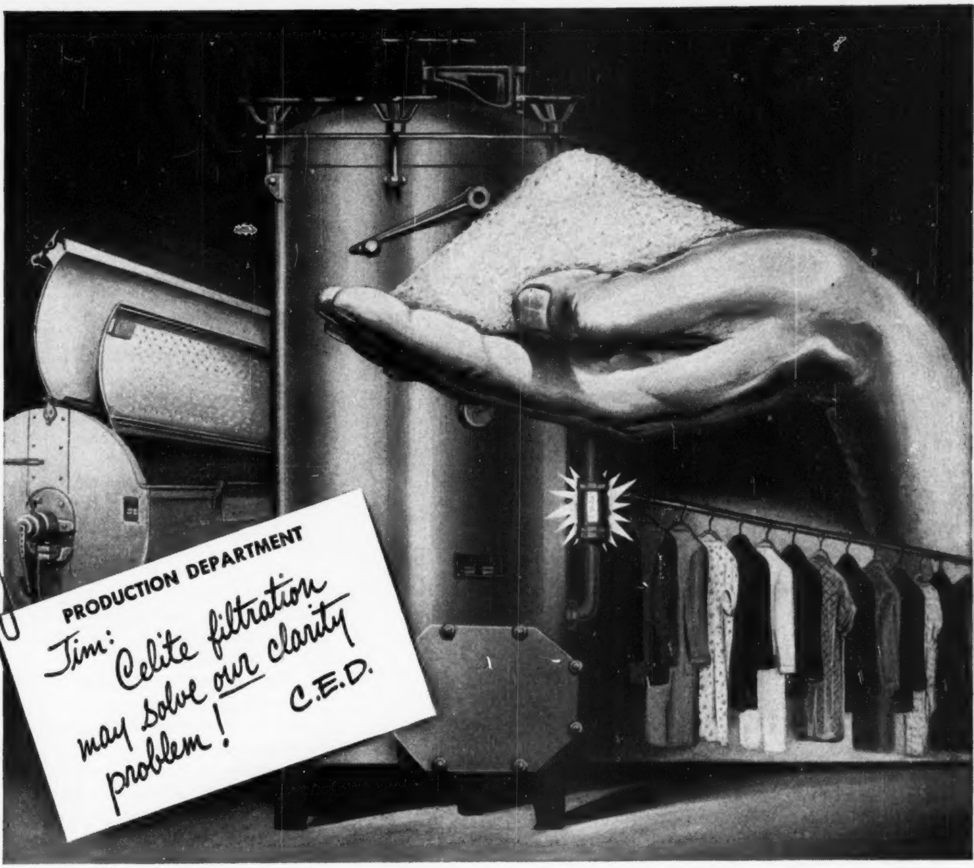
It is feasible to extrude or fabricate plastigels by the ordinary technique of clay or pottery working. The fabricated products can be fused in a shorter time at temperatures of only 300-350 deg. F. to resilient, non-breakable products.

Since only low pressures are required to form plastigels, they can be applied as potting compounds for protecting coils and intricate electrical connections without disturbing delicate connections. Flexibility and low shrinkage during curing are valuable properties in this type of application.

▸Plastisols Foamed—To make the new foamed rubber substitute, researchers evolved a simple three-stage process carried out at low temperatures and pressures. Easy to control, it is at no point a critical chemical process.

The process involves: (1) Expanding the plastisol formulation with a gas in a pressure vessel; (2) discharging the expanded material into an open mold; (3) curing it in an ordinary oven. A tough skin that resists tearing and abrasion forms on all outer surfaces of the molded object as it cures.

This technique was developed by Edmund H. Schwencke of Elastomer


PRODUCTION DEPARTMENT
Jim: Celite filtration may solve our clarity problem! C.E.D.

Chemical Corp., Nutley N. J., in cooperation with Bakelite's research department.

The new foam does not oxidise, dry out or harden, has high resilience and elasticity and is practically odorless. It can be cured directly on natural and synthetic fiber textiles or vinyl plastic film and sheeting.—*Bakelite Co., 122 East 42nd St., New York 17, N. Y.*

Alkyd Resin

For latex emulsion paints.

A new long oil, oxidizing type alkyd of 100 percent solids content has been designed to eliminate several deficiencies of latex paints. The compound contains no solvent, is completely odorless.

Paints based on styrene-butadiene copolymer emulsions often have cohesive properties greater than their adhesive properties. The new alkyd, Aroplaz 1274, corrects this balance by giving its formulations greater adhesion to all types of surfaces.

Low temperatures, which complicate storage and transportation problems by causing most latex paints to permanently coagulate after one freeze-thaw cycle, have no effect after numerous cycles on Aroplaz 1274 formulations.

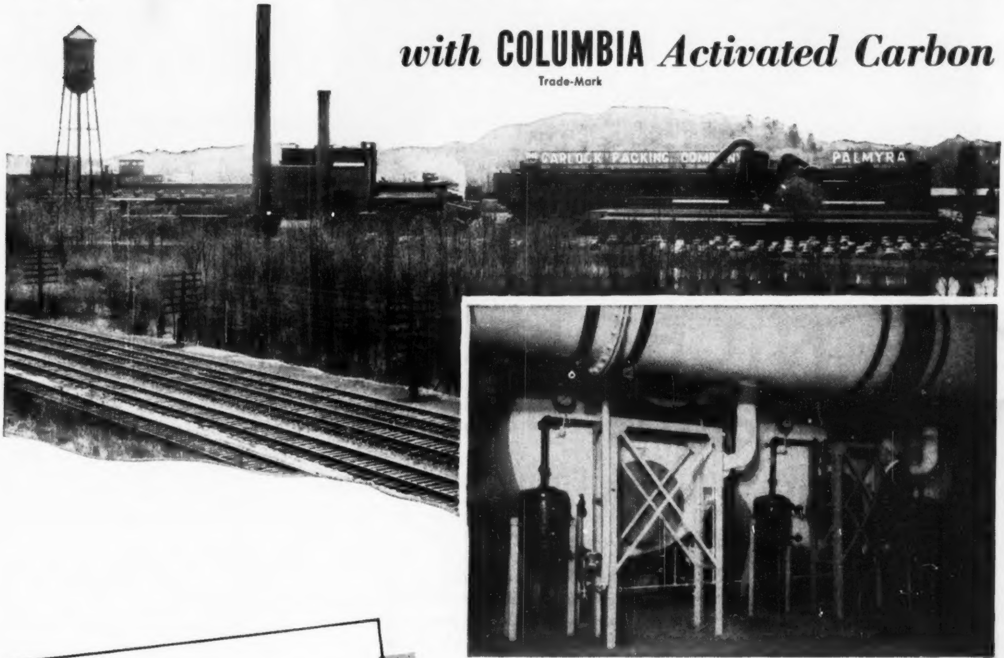
The new alkyd is also said to greatly reduce the long curing time ordinarily required for latex paints to acquire washability. And it imparts high water-resistance during early stages of drying—another quality which most paints of this type lack.

It also offers a greater range of pigmentation than has been possible up to now in latex formulations. Pigment loading in Aroplaz 1274 paints can be adjusted to give sheens all the way from satin to true flat.—*U. S. Industrial Chemicals Co., 120 Broadway, New York 5, N. Y.*

Asphalt Undercoating

For anti-corrosion, weathering and sound deadening jobs.

A tough, sprayable black-asphalt material called EC-1189 can be used to protect metal buildings in fertilizer, paper pulp, plywood and chemical plants. Also, it will protect the exteriors of storage tanks, tank trucks and railroad cars against spillage and water and soil corrosion. *(Continued)*


PALMYRA

Designed primarily to protect underbody parts of transportation equipment from corrosion and abrasion, it meets the requirements of Federal Specification TT-C-520. When sprayed or brushed to $\frac{1}{8}$-in. thickness it dries in about 48 hours to form a tough rubbery hide which will adhere to almost any surface.

For sound deadening, it can be used in the sound trap of air conditioning units and the duct work of air diffusers.—*Minnesota Mining and Mfg. Co., 411 Piquette Ave., Detroit 2, Mich.*

Synthetic enamel, designed to solve the problem of coating chemically inert polyethylene, has been developed. Called Polynamel, the new lacquer has excellent adhesion and withstands the finger nail and scotch tape tests. Unusual toughness and flexibility are claimed for it.—Schwartz Chemical Co., 326 West 70th St., New York 23, N. Y.

Water-soluble, modified styrene polymer resins with a variety of applications in the oil, plastics, paper, paint and other industries are now on the market. Designated as the Lustrex X-700 series, the resins are finely-divided, free flowing, off-white powders that dissolve readily in water to produce stable solutions covering a wide viscosity range.—Monsanto Chemical Co., Plastics Division, Pittsfield, Mass.

Weed killer, 2,4-D, which ordinarily harms tomato plants, has been modified so that certain forms are actually beneficial to them. By chemically combining 2,4-D with certain amino acids prepared in the laboratory, researchers have been able to produce the new form.—U. S. Dept. of Agriculture, Agricultural Research Administration, Washington, D. C.

Fiber glass reinforced sheet is available for the first time in 4-oz.-per-sq.-ft. material in both corrugated and flat surfaces. The translucent structural plastic is said to withstand all weather conditions, is noncorrosive and may be sawed, nailed or drilled with ordinary tools.—Plexolite Corp., 4223 West Jefferson Blvd., Los Angeles, Calif.

A casting resin for embedding electronic components has been de-

veloped which can be made from low cost ingredients, stored without refrigeration, has excellent high-frequency electrical properties. Essentially a modified styrene, it contains a small quantity of acrylonitrile monomer. The latter is very reactive and helps speed up polymerization of the resin.–National Bureau of Standards, Dept. of Commerce, Washington 25, D. C.

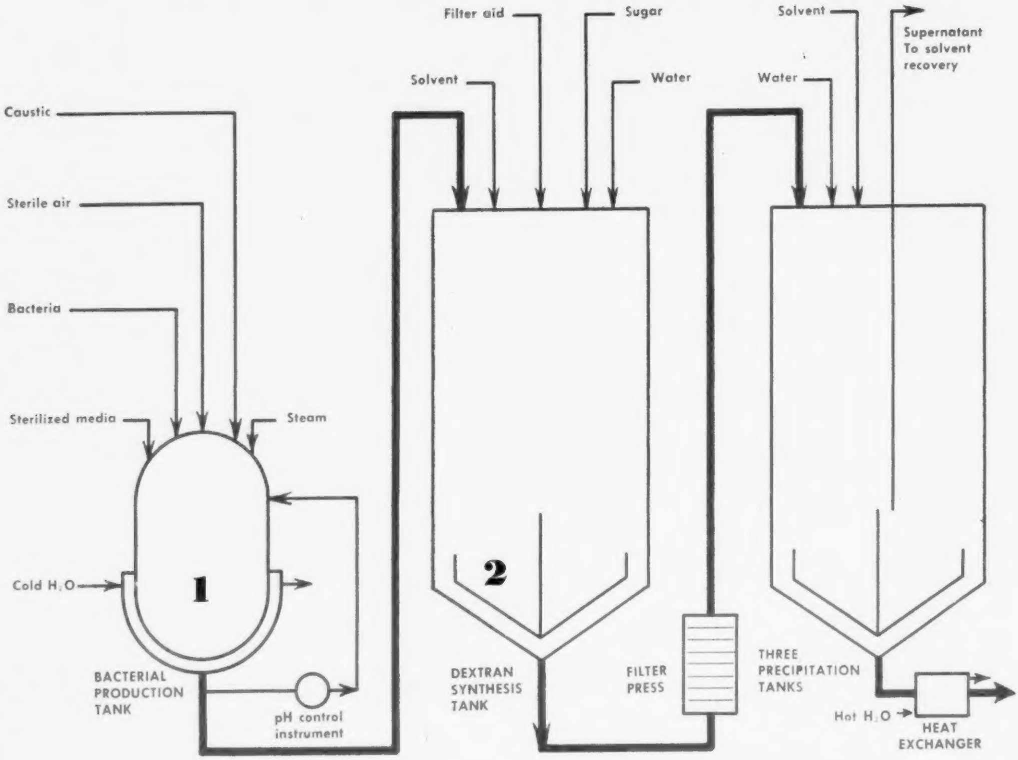
A conductive oil furnace black is now commercially available. It is said to have electrical properties superior to those of standard conductive grades of carbon black now commonly in use by the rubber industry. Called Vulcan C, it will be priced at 11 c. per lb. in bags in carload quantities, fob. Texas Panhandle.—Godfrey L. Cabot, Inc., 77 Franklin St., Boston 10, Mass.

Chlorine trifluoride and bromine trifluoride gases are now available commercially for the first time.–Matheson Co., East Rutherford, N. J.

Synthetic water-soluble wax is being used by Brooklyn Union Gas Co. to make gage valves leakproof during the conversion from manufactured to natural gas. The bonnet of each valve is filled with Carbowax compound which is steamed out easily and completely when they are ready to release the natural gas.–Carbide and Carbon Chemicals Co., 30 East 42nd St., New York 17, N. Y.

Heat-resistant polystyrene plastic called Styron 700 withstands temperatures as high as 220 deg. F., or more than 20 deg. higher than regular polystyrene. It is now produced in commercial quantities.–Dow Chemical Co., Midland, Mich.

Butyl chloride production capacity has been tripled by Carbide and Carbon. A price reduction of six cents a pound should make it attractive as a butylating agent in organic synthesis. It can be used in the preparation of essential oils, pharmaceuticals, dyestuffs, oil additives, rubber chemicals, corrosion inhibitors, plasticizers, and stabilizers for synthetic resins.–Carbide and Carbon Chemicals Co., 30 East 42nd St., New York 17, N. Y. —*End*



Blood Plasma Substitute

WITH the stock pile of blood plasma running dangeriously far behind needs in case of a major emergency a synthetic blood plasma "volume expander" called Plavolex promises to become increasingly important. Clinical tests show that Plavolex can be used as a substitute for blood plasma in about 50 percent of cases. It is especially useful in shock cases resulting from burns, which require large quantities of plasma. The government has placed a number of contracts totaling several million dollars with the manufacturer.

The product was developed from dextran, a gummy byproduct of the paper-making industry, by Commonwealth Engineering Co. of Ohio, Dayton, Ohio. It is an organization of business-trained, scientific specialists that develops products under the sponsorship of manufacturing companies. Plavolex was sponsored by the R. K. Laros Co. of Bethlehem, Pa.

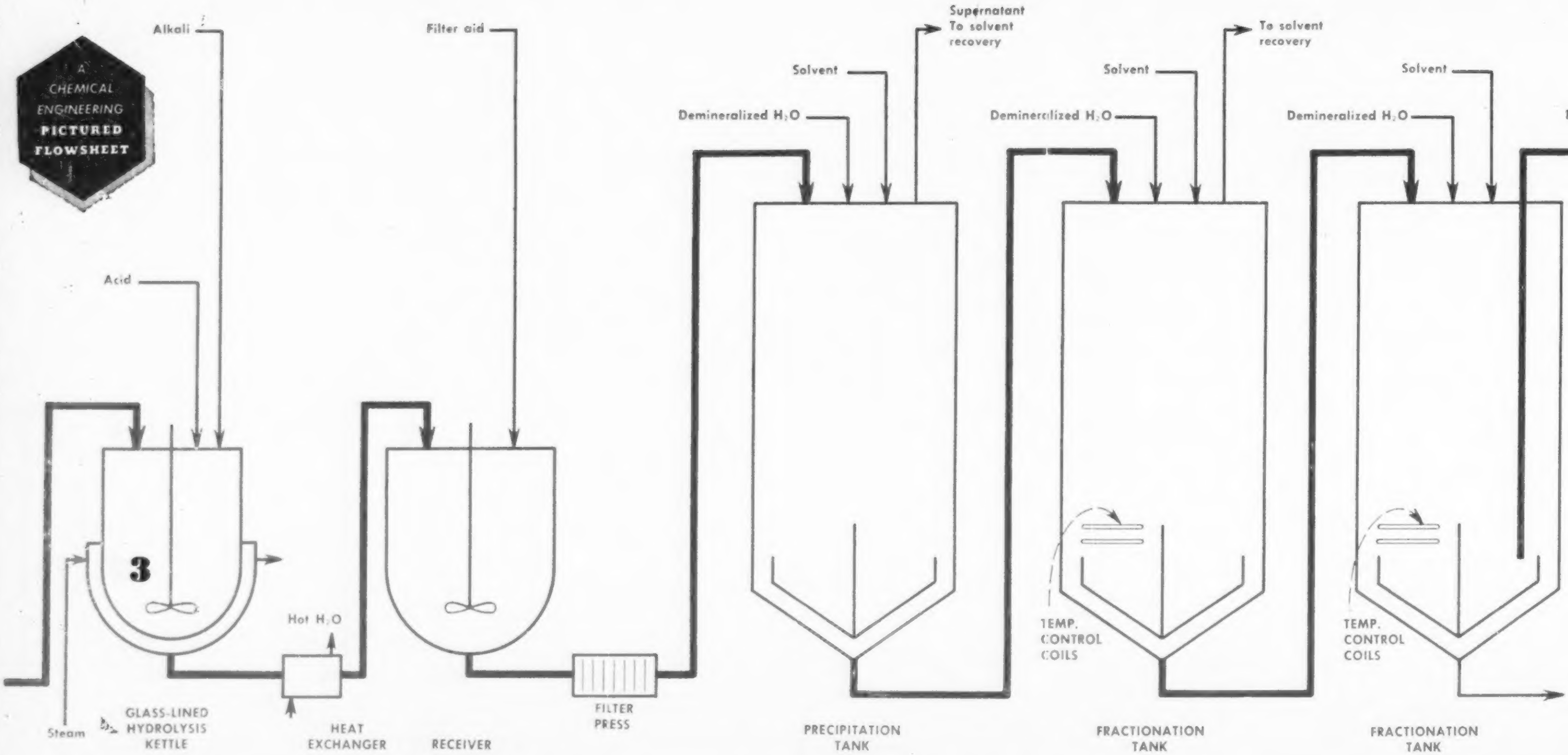
Commonweath, which had previous experience with dextran during its research and product-development work in industrial finishes, has constructed a plant for the manufacture of this new substitute in their Dayton laboratories (see accompanying flowsheet). Production equipment of much greater size, patterned after that use in the Dayton plant, is now being installed in the Laros plant in Bethlehem.

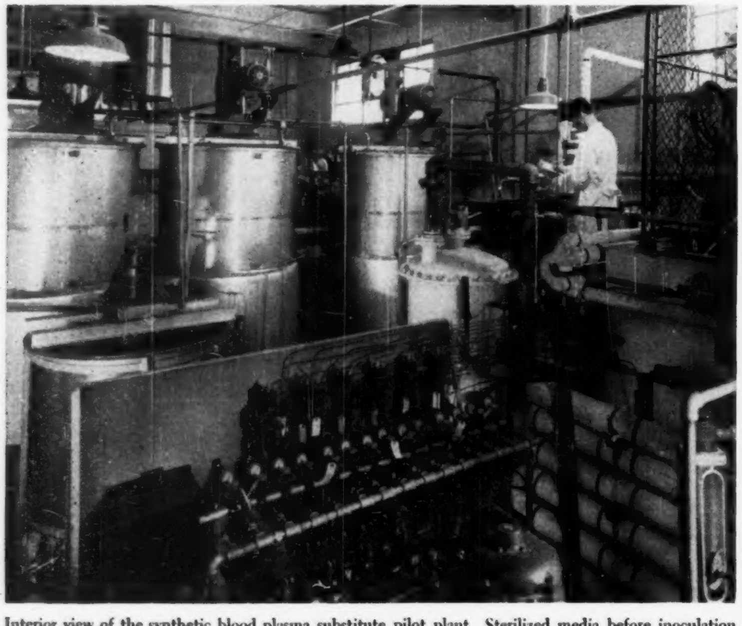
Harmless soil bacteria of a family called Leuconostoc mesenteroides react with sugar to produce dextran. However, there are 64 known strains of this species and the problem was to discover which of the strains was the right one to use in a commercial process.

Later work unearthed the fact that a strain, nicknamed "Luke" by Commonwealth personnel, was the most efficient variety to use during production of Plavolex.

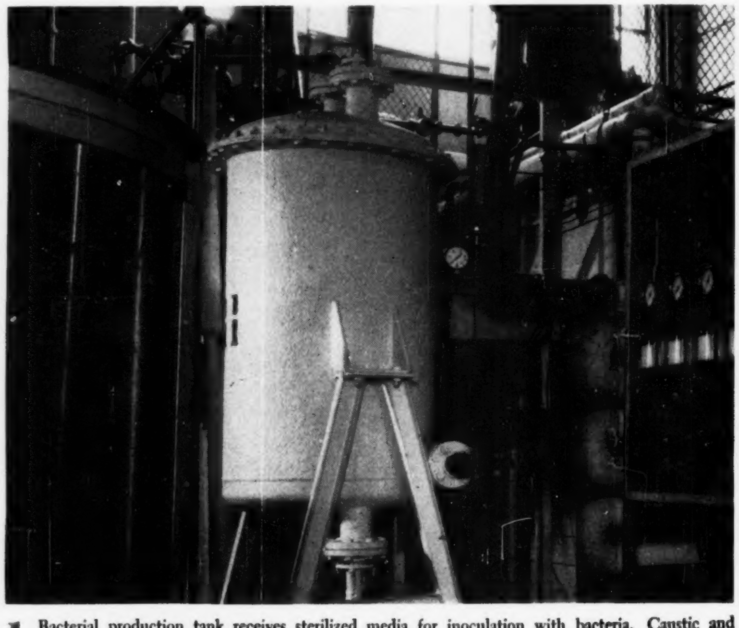
Plavolex production begins when Luke and cane sugar are put together to start a fermentation much like that of the penicillin process. After removal of the bacteria and impurities, the resultant dextran is broken down into minute particles and sterilized. Then it is packaged in a 0.9 percent saline solution in a bottle with a hypodermic needle attached. Then the product is ready for shipment to front lines or warehouses in which much-needed plasma is being stored.

A CHEMICAL ENGINEERING PICTURED FLOWSHEET



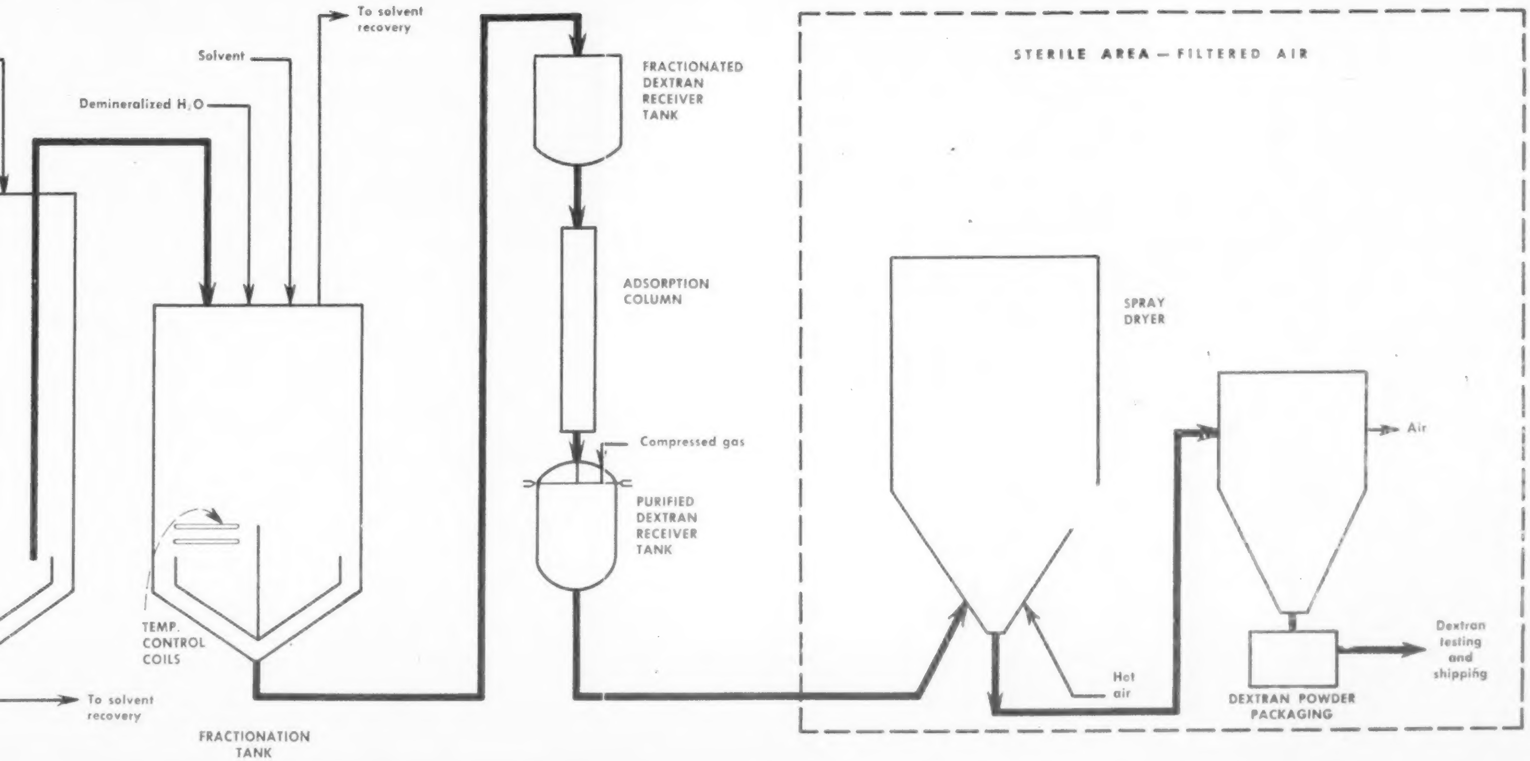


Interior view of the synthetic blood plasma substitute pilot plant. Sterilized media before inoculation goes through the heat exchanger at lower right of photo.



1 Bacterial production tank receives sterilized media for inoculation with bacteria. Caustic and sterile air are also provided for the process.

2 T
c



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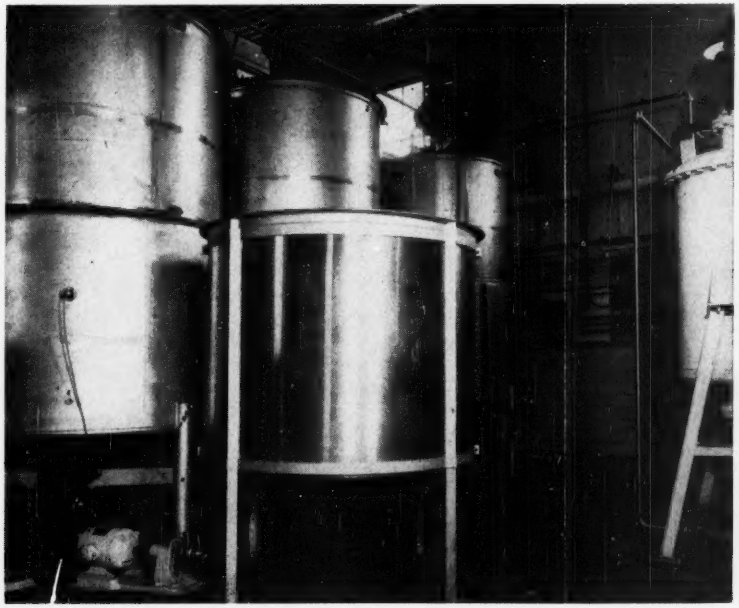
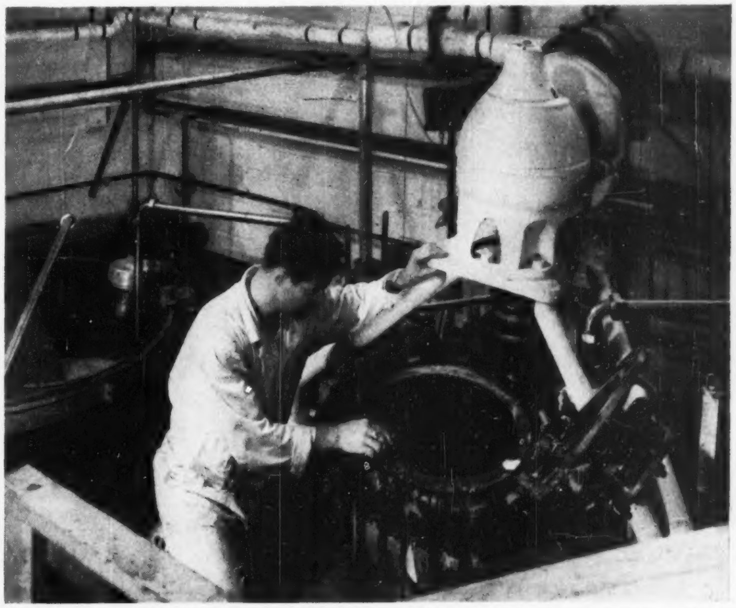


2 The three large tanks in this photo are used to ferment and fractionate the basic sugar and bacteria combination which results finally in blood plasma substitute.



3 Glass-lined hydrolysis kettle receives fermented material from the precipitation tanks. Acid and alkali are both added at this point.

k Valves Cutting

VALVE SERVICE RATINGS

SUITABILITY:	*Doing what's needed*
FEATURES:	*Non-sticking ball disc*
CORROSION-RESISTANCE:	*Shows no effects of Chlorine*
SERVICE LIFE:	*Still O.K. after 3 years*
MAINTENANCE COST:	*Zero - valve never out of service*
OPERATING RESULTS:	*No loss of Chlorine - no unloading delays*
AVAILABILITY:	*Regular Crane product*

N

than 3 years this check has never failed to stop back-flow, and still it's good as new.

THE VALVE

Crane No. 3692XS Cast Steel Vertical Ball Lift Check. Compact and sturdy, with heavy metal sections. Has leakproof male and female joint with corrugated soft iron gasket. Ball disc is solid hard Exelloy, highly polished, with guided seating to integral seat ring. Sizes up to 2 inches. Consult your Crane Catalog or Crane Representative for full details.

Why
Than Any Other Make!

LVES

..., Chicago 5, Illinois
...strial Areas

LUMBING • HEATING

Here is a PROVED DRYING TECHNIQUE for handling CHEMICALLY TREATED CLAY

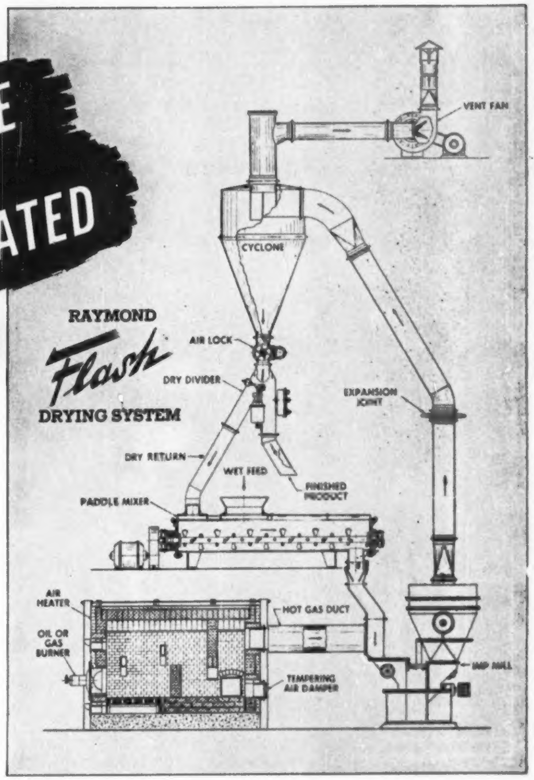
One of the outstanding applications of the Raymond Flash Drying System is the simple method of processing *chemically treated clay* by removing moisture and grinding the material simultaneously in the Whizzer Equipped Imp Mill, so as to obtain a uniform product of specified fineness and dryness.

The clay is received from a filter press, containing as high as 60% moisture. This wet material is first conditioned in the double paddle mixer by blending it with previously dried product, which is returned automatically. This reduces the moisture to approximately 35%.

The material is then introduced to the mill system where the moisture is reduced to 10%, while the material is pulverized to a fineness of 90% passing 325 mesh. The operation is clean, dustless and automatically handled in a single unit of equipment.

This modern method not only gives close control over the finished product while producing a superior quality material, but also saves on operating costs, and results in lower initial investment due to the elimination of expensive mechanical dryers.

These advantages may be applied to a great variety of materials, and Raymond engineers will be glad to advise you if Flash Drying can help solve your problem.



Flow sheet showing Raymond Imp Mill equipped with Flash Drying Accessories for handling chemically treated clay and similar materials of high moisture content.

If you have a *drying-grinding* problem, write for this 28-page . . .

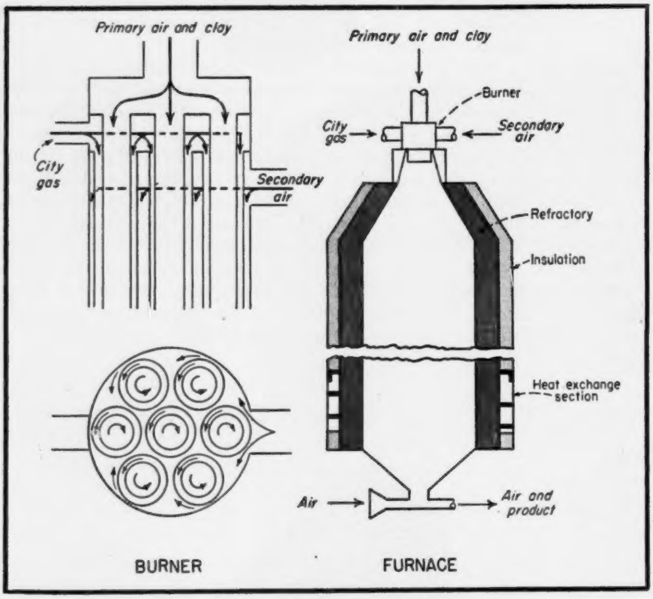
This Catalog describes the use of Flash Drying with the Raymond Roller Mill, Imp Mill and Cage Mill.

COMBUSTION ENGINEERING – SUPERHEATER, INC.

Raymond
PULVERIZER DIVISION

1311 NORTH BRANCH ST.,
CHICAGO 22, ILLINOIS

SALES OFFICES IN
PRINCIPAL CITIES



Making Bubbles From Clay

New seven-tube burner and custom-built shaft furnace had to be engineered from scratch to blow bubbles at 2,700 deg. Result—A new building material.

Development of a new lightweight aggregate with many potential applications in the construction industry was announced recently by Armour Research Foundation, Chicago. Several months' successful operation of a semi-commercial production unit at suburban Blue Island culminates a four-year research program directed by John Neff, assistant chairman of Armour's ceramics and minerals department.

The new material, trade-named Kanamite by Kanium Corp., Chicago, sponsors of the development work, consists of tiny hollow ceramic balloons made by blowing up individual grains of clay in a special furnace. The clay particles are exposed for a fraction of a second to temperatures on the order of 2,700 deg. F. The technique in some ways is like that of a spray dryer, in others more like a shot tower.

▶ **Blowing Bubbles**—A suitable clay is ground to desired particle size in a hammer mill. (To get the greatest yield of the right size, Armour engineers eliminated alternate hammers from the mill and reduced its speed to 700 rpm.) Milled clay is screened to get the wanted fraction, usually 48 to 80 mesh.

Clay particles are fed at a rate of 750 lb. per hr. to a special gas burner by entraining them in the primary air stream delivered by a positive-pressure blower.

The 8-in. diameter burner looks simple enough from the outside, but inside is a cluster of seven tubes, each containing another tube concentrically within (see cut). City gas (800 to 1,000 cu. ft. per hr.) passes through the seven annuli, primary air and suspended clay through the inner tubes, and secondary air around the outer tubes.

▶ **Vertical Furnace**—The burner is mounted at the top opening of a vertical cylindrical furnace. This furnace is 30 ft. high over-all with an inside diameter of 39 in. It is steel-jacketed so that the lower part can be cooled, preheating the secondary combustion air at the same time.

Time of fall, from clay particle leaving the burner to expanded bubble reaching the bottom of the furnace, is estimated at 0.015 sec. Product is picked up pneumatically from the conical furnace bottom and delivered to a bagging machine.

▶ **Can Do?**—Kanamite got its start four years ago when J. D. McLaughlin (now president of Kanium Corp.) brought a handful of home-made bubbles to Armour and asked if commercial production were feasible. Before long, ARF researchers had embarked on a program designed to answer these three questions:

- What was the heat mechanism involved in the spherulizing process?
- How could the material be produced in volume and at reasonable cost?
- What commercial value would the product have in the final analysis?

It didn't take long to duplicate the original material, but this was only the beginning. Commercialization had to await development of a cheap and feasible production technique.

For example, making clay bubbles was easy enough when using an oxyhydrogen burner. But production costs would have been sky-high. Substitution of city gas for hydrogen and air for oxygen were finally achieved; chief problem was to design a burner with a slow enough nozzle velocity to permit the clay particles to expand before they were carried out of the hot zone of the furnace.

Another design problem had to do with the entrance angle of the furnace. Since molten bubbles would coalesce if allowed to touch each other, the angle of flare had to be worked out within narrow limits to assure continued separation of particles as they fell through the hot zone (flame extends about 10 ft. downwards in the 21-ft. chamber of the furnace).

▶ **Breakdown of Oxide**—Expansion of clay particles is apparently due to de-

THUMBTACK gives an indication of size of particles.

composition of iron oxide normally present in these clays (ferric oxide changes to ferrous oxide, liberating oxygen). This mechanism is substantiated by the fact that even precalcined clay with other natural volatiles (H_2O, CO_2, SO_2, SO_3) driven off will form bubbles when treated by this process.

As a rule of thumb any clay suitable for red brick can be used, but different clays give different results. Bubble size (usually about 0.02 in.) depends on the clay used as well as the method of processing.

▶ **Product Potential**–Application of Kanamite in the building trades depends, of course, on its properties and cost. It is light (17 to 25 lb. per cu. ft.) and chemically inert; particles are uniform in size, non-absorbent and strong–plaster specimens made with Kanamite are reported to be stronger than those made with sand.

Use of Kanamite instead of sand in concrete mixes makes for a very fluid mix. This fluidity might mean that concrete can be pumped directly into forms through rubber hoses.

Another suggested use is as a filler in plastics.

Material from the present plant costs about \$50 per ton (\$14 per cu. yd.). A full-scale plant could probably earn a profit at \$35 per ton.

Contract Awarded for Design Of Shale Oil Refining Unit

A new catalytic refining unit for the oil-shale demonstration plant of the Bureau of Mines at Rifle, Colo., will be designed by the Catalytic Construction Co. of Philadelphia. A construction contract on the 50-barrel-a-day unit will be awarded in fiscal 1953 if adequate funds are appropriated to the Department of Interior.

Catalytic Construction's bid for process and engineering design was \$36,000, plus a fixed percentage of salary overhead to cover such expenses as facilities, equipment and supplies used by the contractor's employees. Three other bids were received in which estimated costs and fees ranged upward to \$44,000, not including the percentage overhead.

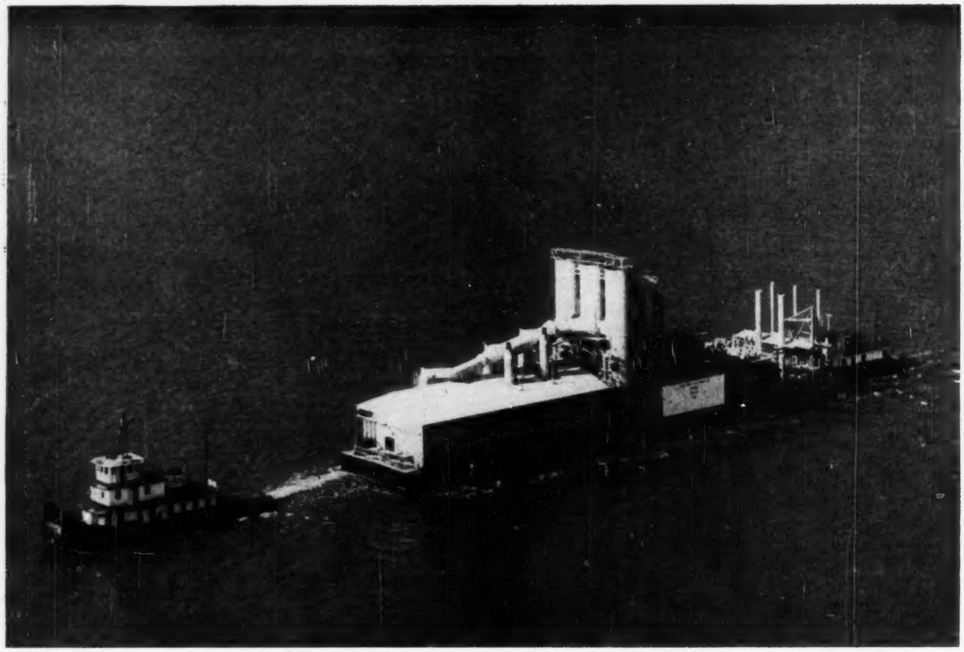
The proposed experimental catalytic refining unit would recover better yields of specification-grade gasolines, diesel fuels and jet fuels from the shale-oil distillates now produced in the thermal refining unit at Rifle, Colo.

In addition to the increased yields of gasoline and diesel fuels, possibly as much as 25 percent, the anticipated advantages of the catalytic unit also include better quality products at lower cost.

The catalytic refining unit will be designed to process a variety of charge stocks, either with or without the addition of hydrogen, over a wide range of experimental conditions with the objective of developing techniques to (1) remove the unwanted sulphur, nitrogen and oxygen compounds in the shale-oil distillates or convert them to forms readily removed; and (2) effect molecular rearrangement or alteration of the hydrocarbons to improve product quality.

SOUTHWEST EDITOR'S NEW HEADQUARTERS

From his new office on the thirteenth floor of the Prudential Building, where McGraw-Hill has just opened headquarters for its growing Houston operations, James A. Lee, Southwest Editor of Chemical Engineering, will cover the booming process industries of the dynamic Southwest. In typical Texas fashion, the Prudential Building stands high, wide and handsome on Holcombe Blvd.



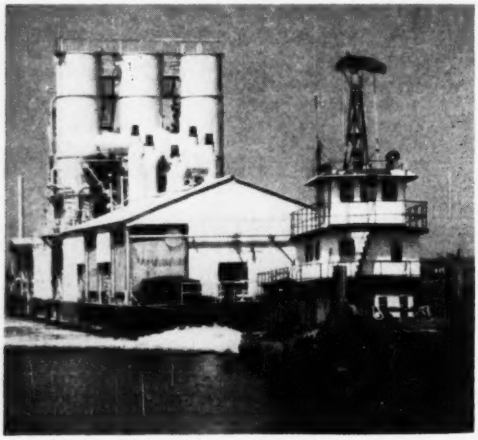
Louisiana Sea-Ride

Freeport Sulphur Co.'s unique amphibious Frasch plant recently dropped anchor at Bay Ste. Elaine, in the Louisiana marshes.

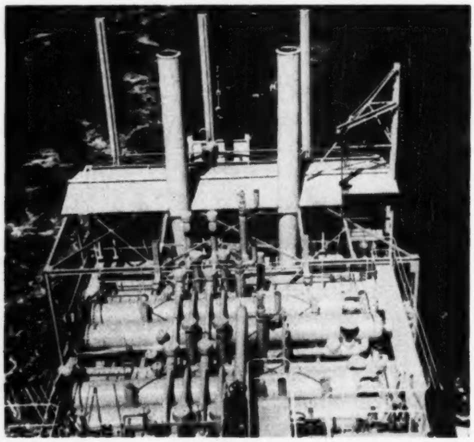
Built 65 miles away, at Grand Ecaille, the floating sulphur mine was towed over open water and through bayous to its first campaign of producing sulphur from underwater domes. When the Bay Ste. Elaine deposits play out, the plant will weigh anchor and sail to the next point.

Success of this operation will hinge on Freeport's process that permits use of brackish water for Frasch mining (see *Chem. Eng.*, May 1952, p. 274). Water is heated and deaerated in the three large towers to avoid scale and corrosion. The operation will use some 1.75 million gal. per day of 325-deg.-F. water.

Molten sulphur from the well will be transported by barge to land-based storage.

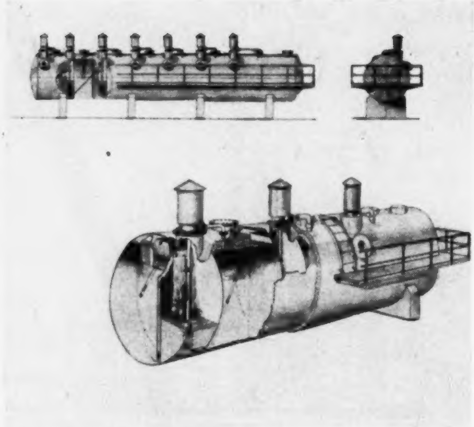


DEAERATING towers loom large behind the boilers.



TOPSIDE equipment; below are pumps, compressors, etc.

THREE-ROLL mixer attracted attention at the Leipzig Fair.



EXTRACTOR is used for countercurrent dephenolizing process.

Chemicals Behind the Curtain

East Germany's chemical industry seems to be back in stride. Here's a brief look at recent developments in processes, products and equipment.

East Germany, faced with serious shortages of many basic raw materials—coal, iron, copper, sulphur, rubber, timber—is making heavy demands on its chemical industry to find substitutes and devise new uses for waste products of industry.

Under the five-year plan (1951–1955) now governing the economy of the country, the chemical industry has a high priority. Twofold aim is a vast expansion of heavy industry in East Germany and a rising output of chemical products to sell on the world market.

▶ **New Sulphuric Source**—According to reports brought back from the Leipzig Fair in September, the East Germans are said to be producing sulphuric acid from a magnesium sulphate base. Although process details haven't been disclosed, a plant is known to be working at Leuna, former I. G. Farben dye center.

Magnesium sulphate (or kieserite, as the Germans call it) is abundant in the vast potash deposits of the Harz Mountains region. Its use for sulphuric acid has been officially hailed as the beginning of "a new phase" in East German chemical industry. Target acid output for 1955 (believed to have been set before the Leuna plant began operations) is 450,000 tons, or about double the 1950 mark.

▶ **Rich in Potash**—Although poor in most vital materials, East Germany has a wealth of potash deposits. According to most recent figures on world supplies, Germany has more natural potassium salts than the rest of the world together. And something like two-thirds of them are in the Eastern zone.

Exploitation has been stepped up in recent years; Eastern Germany is reported to be exporting more potash than was ever sent abroad by the entire prewar German industry. Current production of K_2O is an estimated $1\frac{1}{2}$ million tons a year. This will be increased still more under the five-year plan.

At the present time the East German industry is said to be producing all known fertilizing salts. Latest to be developed are those which include magnesium. These potash-magnesia fertilizers contain, in addition to potassium in its various compounds, magnesium as a sulphate.

One of the new products, known as Emgekali ("Emge" for Mg, "kali" for K), contains 33 to 37 percent K_2O, at least 15 percent $MgSO_4$ and boron up to 0.2 percent B_2O_3. Another one, Reformkali, has 26 percent K_2O, 26 percent $MgSO_4$, and a maximum of 12.5 percent Cl. (The low chloride content is supposed to be of particular value for certain types of crops, such as potatoes, kernel fruits and tobacco.)

Others are magnesia-kainite, with 12 to 15 percent K_2O and a minimum of 15 percent $MgSO_4$, and magnesia-sylvinite-kainite, with 16 to 20 percent K_2O and 15 percent minimum $MgSO_4$.

▶ **Better Shipping**—Transport has been the bottleneck in East Germany's expanded fertilizer export program. Wismar is being developed as a transshipment port for potash products. The port and approaches have been deepened, permitting ships up to 7,000 tons to berth; further deepening now under way will provide accommodations for 10,000-ton vessels, particularly those bound for the Far East, where the Germans are selling considerable amounts of fertilizer.

Mining methods are said to be improving, but mechanization must be carried still further to meet the desired output. One new piece of equipment now operating in rock salt mines is a gallery-working machine with a driftway diameter of 3 meters. It is capable of working 14 cu. m. of salt at an average drive of 2 meters per hr.

▶ **Man-Made Fibers**—The East German synthetic fiber industry may emerge as a keen competitor in world markets within a few years. Virtually

destroyed during the war, the industry has been given a high priority by the Russian governing authorities.

If 1955 targets are reached, rayon output will be 34,500 tons per year (four times 1950) and synthetics will be 127,000 tons (ten times 1950). Development of the industry on such a scale is based on stepped-up production of the necessary machinery and equipment. Output of equipment for the rayon industry, for example, will have to increase seven times.

East Germany's textile machine industry, concentrated in Saxony and Thuringia, is known to be developing several new spinning machines for synthetic fibers. A rayon spinning machine with a performance continuous to three quarters is being used in large-scale production. The former eight stages from the spinning machine to the finished yarn have been reduced to three, and the resultant product is said to be especially suitable for dyeing.

Feature of a new spinning and bobbin-winding machine for rayon and other fibers is a drum with crosswise grooves to guide the thread as it is wound on the bobbin, instead of the customary thread guide. The risk of thread breakage is said to be reduced and a considerable increase in winding speed is obtained.

► **Germany's Nylon**—Perlon is the most interesting of East German synthetic fibers. Comparable to nylon in properties, its output this year will be almost doubled in an attempt to meet domestic demand and provide exports for Far Eastern and other markets.

Perlon stockings are an important export. The fiber has just been introduced into the knitting and weaving industries. Industrial uses are increasing. It has proved suitable for spindle ribbon in cotton spinning and twining mills, deep-sea fishing lines and, impregnated with rubber, the track of a new 60-hp. tractor just getting into production. In this latter use, the saving in weight compared with a steel track is put at 3,700 lb.

► **Rayon Developments**—The viscose industry in the Russian zone is producing fabrics up to the finest numbering for weaving and knitting mills. There is a growing trend to makeup in large-sized cones. It was recently reported that hank rayon will in the future be made only when cones cannot be used for reasons of dyeing technique. In

addition to the well known Mikrosol colors, new high-grade dyes made in East Germany are now being used.

In spite of the higher price, the East Germans are reported to be using cuprammonium rayon for ladies' light dress material and for hosiery. Where viscose is still in use for hosiery, moist cones are favored because they yield 10 to 15 percent more first-quality yarn than the normal stocking fiber.

The rayon industry is supplying cord for tires; viscose tire cord, in fact, has become an export commodity.

▶ **News in Plastics**—Plastics is another field of East German effort. A polyvinyl chloride plastic with considerable elasticity has been used for fenders on light cars after a successful road test of over 100,000 miles. It is claimed that plans are in hand to make entire plastic bodies for passenger cars. Car fittings, including headlights, have already been made.

Two new plastics have extensive industrial applications. One of them, known as Silikon, is presumably similar to our silicones. It is used as an insulating material in the manufacture of motors and generators, making possible smaller motors for the same power and the use of aluminum windings. Wire of copper or aluminum is treated by passing it through a bath of Silikon and drying at 100 to 120 deg. C.

Igurit S and Igurit AS are now being widely used in Eastern Germany for construction of process equipment, especially for absorbers in the manufacture of acids. Igurit S is claimed to be resistant to HCl, solutions of inorganics, hot ammonia, H_2SO_4 at 60 deg. C., cold organic solvents, etc. Top temperature limit is 180 deg. C. Igurit AS is, in addition, resistant to dilute and concentrated cold or boiling alkalis, hypochlorites, chromium acid solutions, acetone, amyl acetate, aniline, concentrated acetic acid, concentrated sulphuric up to 70 deg. C., and temperatures up to 300 deg. C.

▶ **New Equipment**—Reports of a newly developed plastics injection machine have recently come out. It is said to combine several new features—improved oil cooling, an electric heater to increase injection speed, piston pressure adjustable from 6 to 15 tons, molds opened and closed by oil pressure and thermostat-controlled constant temperature.

Among the equipment exhibits at the Fair was a new three-roll mixer. It is designed for preparation of PVC

plastics, paint and printing inks. It features pendulum-type bearings with gears running in a fully enclosed oil bath. The largest of three models weighs 4½ tons, having an output of 330 to 660 lb. per hr.

Also shown at the Fair was a model of a countercurrent extraction machine used in a dephenolizing process developed by Dr. Alfred Dierichs. The Dierichs process employs the usual selective solvent, butyl acetate, but a seven-stage extraction takes the place of the former three stages; it is said to have reduced the final concentration of phenol from 120–150 mg. per liter to a maximum of 50 mg. per liter.

Makers of Printing Inks Plagued by Shortages

Shortages of cobalt compounds, cadmium selenide and steel containers are besetting the printing ink industry.

Cobalt and selenium, needed for critical ferroalloys, are still in short supply. Much cobalt still comes from Africa and imports have improved only slightly. Military demand and stockpile needs preclude any improvement in amounts going to industry for civilian uses.

Selenium is a byproduct in the electrolytic production of copper. Any increased output of selenium depends on increased electrolytic copper production—not presently expected.

Steel for containers, especially black plate sheet, is extremely hard to get. Makers of printing inks can expect little easing of this shortage before January or February 1953.

Although tungsten is scarce, price differentials have led to widespread substitution of molybdate colors in place of tungstates and the industry probably won't return to the use of tungsten compounds in printing inks. Tungstates are now used only for certain special color printing purposes.

Other metals used in printing ink compounds, such as tin, lead, zinc, molybdenum and chromium, are in fair to good supply, according to the NPA.

Linseed, soybean and castor oils, used as drying oils, are in ample supply, according to the Department of Agriculture. U. S. production of tung oil for 1952 will reach a record 35 million pounds.

A New Way to Make Dicalcium Phosphate

A new process, which rids phosphate of fluorine, will make a feed grade dicalcium phosphate with wet-process phosphoric acid. Key: fractional precipitation.

Because rock phosphate contains too much harmful fluorine, wet-process phosphoric acid has never been used before to make feed-grade dicalcium phosphate. At the present time practically all feed-grade dicalcium is made from electric-furnace phosphorus, where fluorine is driven off during firing.

This situation, however, is due for a change. Starting with phosphate rock and using a wet process, Texas City Chemicals, Inc., will by mid-1953 be turning out 56,000 tons annually of feed-grade dicalcium phosphate. The product will have a maximum fluorine content of 0.1 percent, well below present limits set by the Association of American Feed Control Officials.

The new $7-million plant at Texas City (see *Chementator*, Sept. 1952, p. 104) will use processing schemes developed by W. R. Seyfried. Chemical Construction Corp., Seyfried's present employer, started construction on the plant this past June; Seyfried will eventually go with the new company to direct production.

Seyfried's process takes almost all the fluorine out of wet-process dicalcium phosphate. In so doing it produces as co- or byproducts sodium silicofluoride and fluorine-containing fertilizer-grade dicalcium. At the proposed level of production at Texas City, these will be made in quantities of 15,000 tons per year each.

▶**Getting Out the Fluorine**—In the Seyfried process, brine precipitates sodium silicofluoride from the solution of wet-process phosporic acid. Most of the fluorine in the acid comes out of solution in this operation. Then lime is used to make dicalcium phosphate from this acid.

This is done in two steps. The first step, which brings down just about all fluorine remaining in solution, gives a fertilizer-grade dicalcium; the second, the feed-grade major product.

In the other operations, conventional methods are used to make sulphuric acid, wet-process phosphoric acid and milk of lime. With this exception, however: In making phosphoric acid, a weak sulphuric acid is used. Also, contrary to common practice, the phosphoric obtained will not be concentrated.

To get the weak sulphuric, Texas City signed an agreement with the nearby Carbide & Carbon plant. According to the agreement, Texas City will first make a concentrated sulphuric acid, about 300 tons a day, and then pipe it to Carbide. From Carbide it will get back a spent acid (50 percent H_2SO_4 minimum) and a set payment.

Expected Feed Grade Product

P_2O_5	38.00–40%
Lime	31.20
F	0.05
Fe_2O_3	0.12
Al_2O_3	0.15
MnO_2	0.16
S	0.07
Moisture	0.63

▶**How Process Works**—Phosphate rock first passes from a 1,250-ton silo to a Raymond mill, where it will be pulverized to 60 percent through 200 mesh. The ground rock then will pass to another 1,250-ton silo.

To make the phosphoric acid, a Fuller-Kinyon pump will carry the rock to a premixing tank, where it will meet a stream of recycle phosphoric acid washings.

The mix will go to three 8,500-gal. stainless steel agitated digesters (a fourth digester will serve as a spare). Spent sulphuric acid from Carbide, which has been held in three 50,000-gal. measuring and storage tanks, will be pumped with the mix through the digesters.

From the digesters the suspension of calcium sulphate and phosphoric acid at about 160 deg. F. will run on to a horizontal, platform-type Oliver filter, 15 ft. in diameter. Product from the filter, which will operate at a 20-in. vacuum, will be a weak phosphoric, between 15 and 18 percent.

Phosphoric washings may be sent back to the premixing tank to help control the size of the gypsum crystals. The other acid will pass to a vacuum cooling system. The temperature of the solution will be cooled from about 140 to 85 deg. F. From the two-stage rubber-lined vacuum coolers, the acid solution will go to three 50,000-gal. intermediate storage tanks. All operations during acid making will be governed by temperature and pH controls.

▶**Purifying the Acid**—To precipitate the fluosilicic acid impurity, the solution will go from storage to a brine tank. Salt brine will flow into the tank under a ratio-controlling system, precipitating sodium silicofluoride. In this operation, about 75 percent of the fluorine will drop out of the solution.

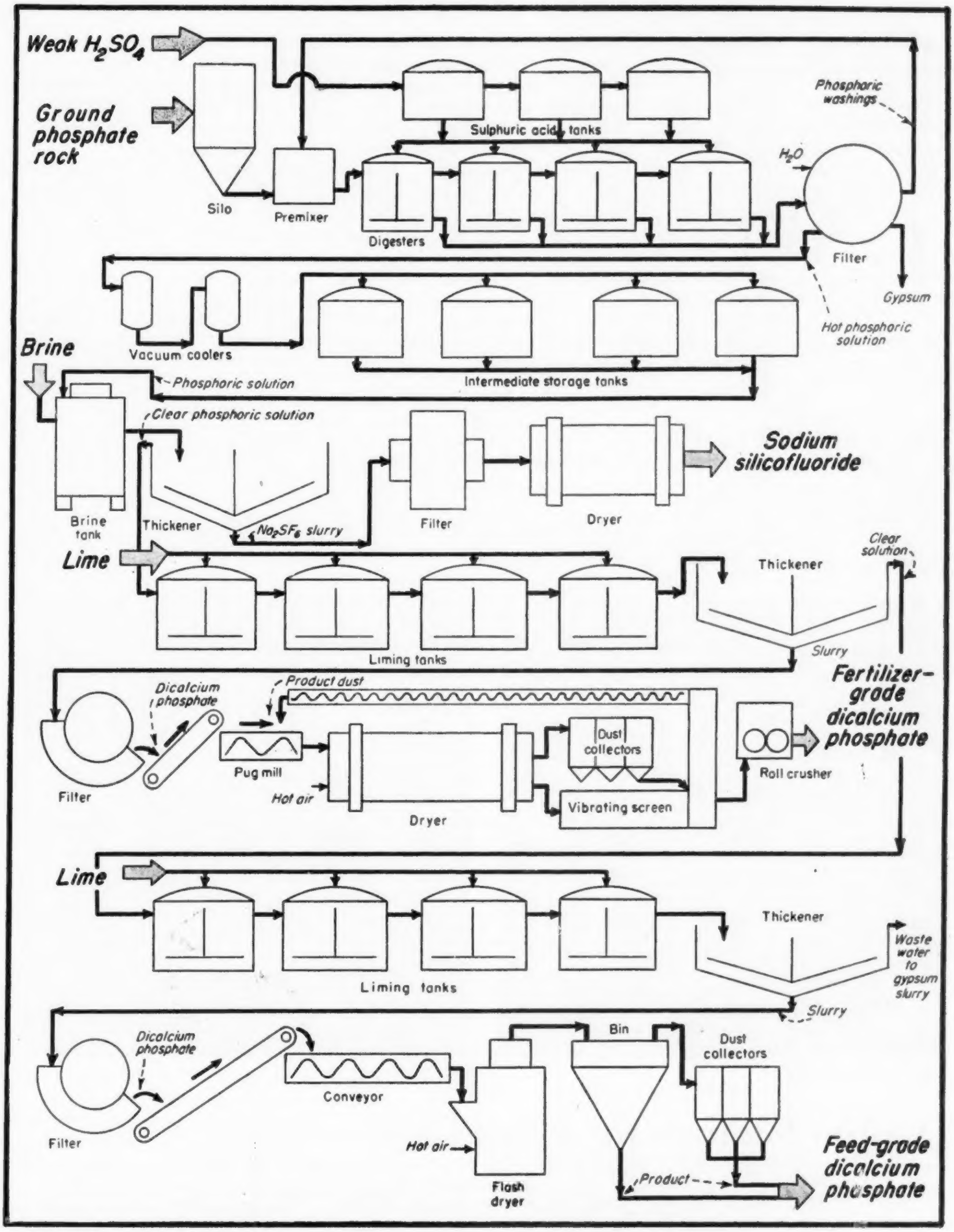
From the brine tank the mix will go to a thickener, to remove the precipitate. Thickened slurry of sodium silicofluoride will be pumped to a Dorrco filter. The cake will go first to a rotary dryer, then to a packaging machine. Clear phosphoric passes on to a 3,500-gal. overflow tank.

To make milk of lime, lime drops from a 700-ton silo (about 90 tons will be used each day to make 225 tons of dicalcium phosphate) to a Hardinge lime slaker. From here, the slaked lime at 200 deg. F. will go to a separator for removal of grit. The overflow, consisting of about 10 percent milk of lime, will be cooled in a vacuum cooler to 100 deg. F. (The vacuum system is similar to that used in the phosphoric cooling.) Automatic controls will be used throughout.

▶**Precipitation Steps**—To make the dicalcium phosphate, phosphoric acid and milk of lime, the latter flowing in a circulating system, will be mixed in a series of four 10,000-gal. liming tanks. The last tank will discharge the mix into a 40-ft. wooden thickener.

To make fertilizer-grade dicalcium phosphate, slurry from the thickener will be first pumped to a rotary vacuum filter. The filter cake will then be conveyed to a pug mill to be mixed with product dust. From the mill, the mix will pass through a Roto-Louvre dryer to a vibrating screen. The collected dust goes back to the pug mill, and pellets (not larger than 20 mesh) pass directly to a bagging machine.

If the company wishes to make a smaller product, it will have a roll crusher ready to reduce the pellet size.



FRACTIONAL PRECIPITATION IS THE KEY TO A NEW PHOSPHATE PROCESS.

The new product would be 100 percent smaller than 50 microns, with the bulk around 10 microns.

To make the feed-grade product, the clear solution from the thickener will pass through a second liming operation, identical to the first. Also like the previous operation, mix will go to a thickener; the slurry removed and filtered; then the filter product dried. Unlike the other operation, however, the filter cake will be dried in a flash dryer rather than a Roto-Louvre dryer. Both liming operations will be automatically controlled and pH checked.

Apex Will Make Aluminum From Clay by New Process

Apex Smelting Co. of Chicago will build a silicon aluminum plant on a 13½-acre site in Springfield, Ore. The new plant will use aluminum silicate clay from the Cottage Grove, Ore., area to make aluminum ingots.

Apex has been working with the U. S. Bureau of Mines at Albany, Ore., to develop an economical process for making aluminum from clay.

Construction is expected to start this winter. Complete plans, including the amount of money to be invested, will be disclosed later.

Tel Aviv Plant Will Convert Waste Into Organic Fertilizer

A plant to convert garbage into organic fertilizer, the first of its kind in Israel, will be built at Tel Aviv. Construction will start within six months.

Garbage collected at Tel Aviv will yield about 60,000 tons of organic fertilizer per year, or 40 percent of the requirements of the southern area of the country. J. Green & Co., Ltd., of Palestine has been granted a 30-year concession by Tel Aviv.

After inspecting garbage disposal plants in the United States and in Europe, A. S. Cohen, managing director of J. Green & Co., predicted the commercial operation of such plants would be equally successful in Israel.

While in the U. S., Cohen discussed the participation of American investors in this project to the extent of $400,000 in U. S. dollars plus the equivalent of another $400,000 in Israeli pounds.

Paint Makers Face Threat Of Scarce Chemicals

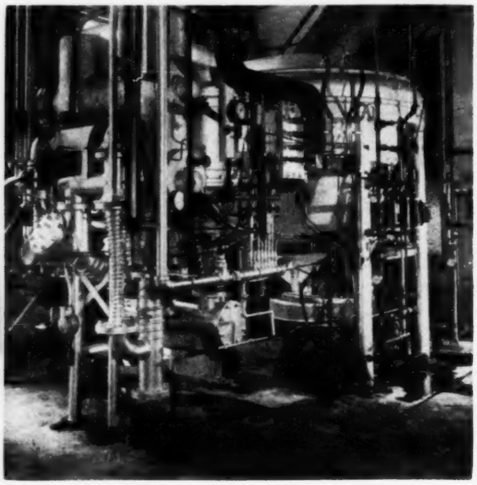
Paraphenylphenol resin will be hard to get for some time after the first of the year. About 40 percent of the present supply, according to NPA, is going to the Navy for marine paint, but that demand may be reduced. This would free more resin for defense industries, especially the manufacture of insulating varnishes.

Methylene chloride for non-flammable paint removers presently is in balance. But NPA expects defense requirements for the next three months to exceed production.

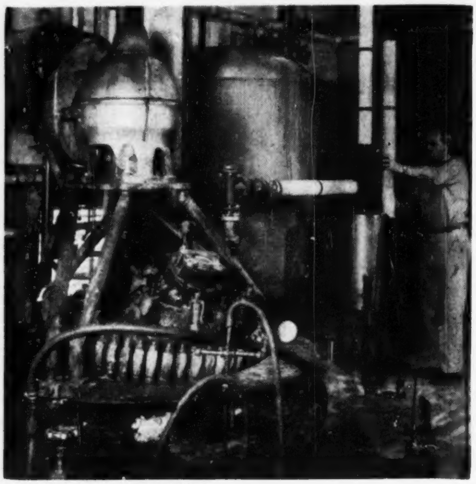
Expansion in titanium dioxide will fall short of the 1954 goal unless new facilities for production of about 50,000 tons can be completed by that time.

Cobalt is still in short supply, and with jet engine production soaring may grow even more scarce.

Chromite for color production is in balance, according to NPA, but could become tight if military requirements increase. No problems are currently being encountered by makers of marine paints in getting tin containers.



MOLECULAR STILL



ESTERIFICATION UNIT

Double Feature for Expansion

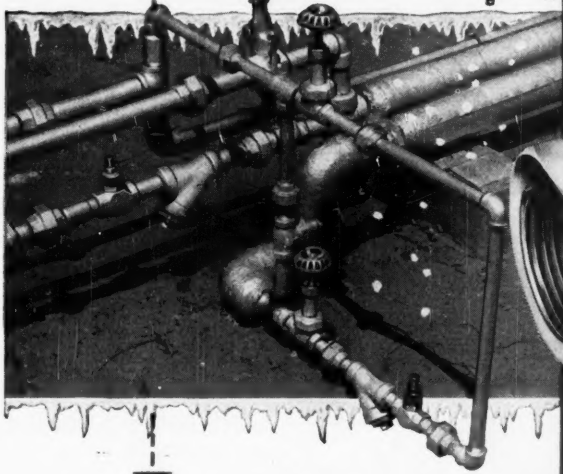
To increase output of synthetic products from fatty acids, Arnold, Hoffman & Co., Inc., in a major expansion move, has installed a new molecular still and a completely new esterification unit at the Cincinnati plant of its Harkness & Cowing Division. The molecular still was built by Distillation Products Industries, a division of Eastman-Kodak.

The expansion results from an earlier decision by Arnold, Hoffman to transfer manufacture of synthetic products from its Dighton, Mass., plant to the Cincinnati location, where Harkness & Cowing produces the basic raw materials.

Because of the prime position of Harkness & Cowing as a producer of fatty acids, the Cincinnati plant has become the key to Arnold, Hoffman's manufacture of such synthetic products as distilled esters, distilled oleic acid, softeners and wetting agents.

Active expansion of vat dyestuff facilities at the Dighton, Mass., plant, where the synthetic products were formerly manufactured, was another reason for the move. Manufacture of synthetic products will now be combined with production of basic raw materials for these products at Cincinnati.

these steam traps won't freeze up!



Freeze-ups of outdoor steam traps in winter weather often cause production delays. Don't take that chance . . . especially when it's so easy to install Yarways, the steam traps that *won't freeze up.*

They won't freeze because condensate does not accumulate. The only moving part—a little valve—is continually testing for condensate, discharging it as soon as it forms. There's never anything to freeze.

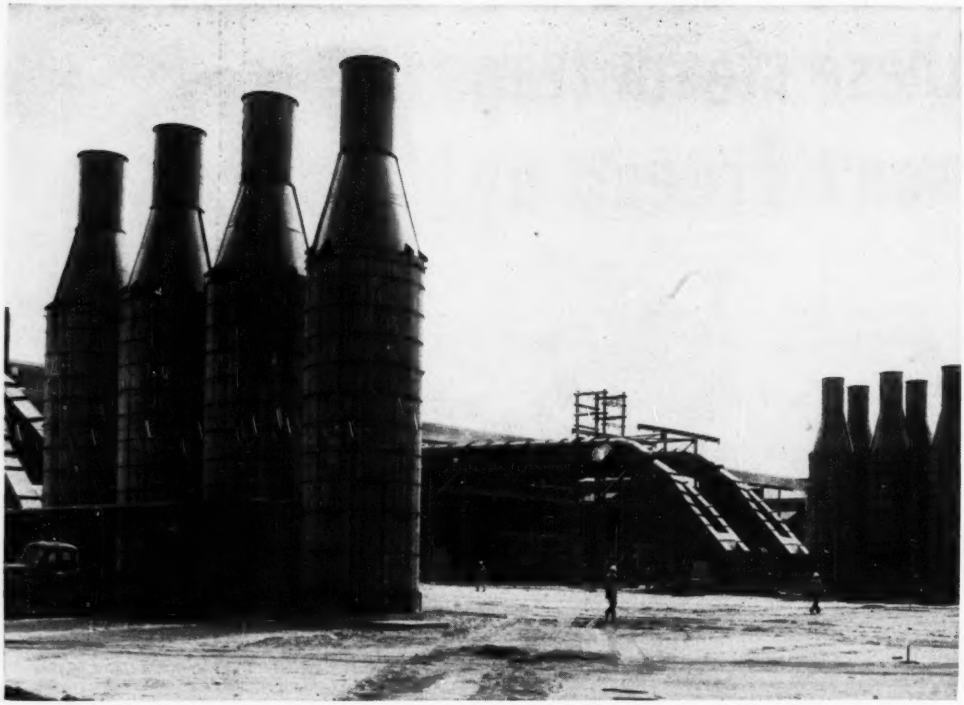
Other reasons why over 750,000 Yarway Impulse Steam Traps have been sold—they get equipment hotter, sooner; light weight; small size; easy to install and maintain; good for all pressures; made of stainless steel.

More than 200 industrial distributors sell Yarway Traps and Strainers. See your nearest one today. For name, and free 24-page Steam Trap Book, write . . .

YARNALL-WARING COMPANY
137 Mermaid Ave., Philadelphia 18, Pa.

YARWAY

the steam trap designed with more production in mind



SCRUBBING TOWERS remove fluorine from aluminum plant exhaust gases. Each tower is 10 ft. diameter by 46 ft. high.

Triple-Threat Fume Disposal System

New Kaiser installation keeps atmosphere clean and workers comfortable, for good measure recovers 35 tons per day of valuable dust.

Six of the eight potlines at Kaiser Aluminum and Chemical Corp.'s Mead, Wash., plant have now been tied in to the new $5-million fume disposal system. Work on No. 6 was completed this month; the entire job will be finished next spring.

An extensive collection system picks up the exhaust from each individual pot, passes it through dust collectors and scrubbers in order to remove solids and fumes, releases clean air to the atmosphere. When complete, the system will comprise more than 13 miles of steel pipe and ductwork, ranging in diameter from 12 in. to 7 ft.

▶**Good Relations**–Fume control is necessary from the standpoint of preventing air pollution. Kaiser has another objective, however–improving working conditions within the plant.

In order to achieve these aims the fume control system must capture the exhaust at its source–the aluminum reduction cells, or pots. Shields on each pot prevent escape of gas, dust or air into the building and, at the same time, cut down the amount of heat released within the building. There are eight aluminum side shields and two aluminum end shields per pot, all removable for pot operation. Top and other shields are made of steel and are permanently fixed to the superstructure.

A 12-in. duct, also fixed to the superstructure, is connected to each pot. Each of these empties into a large collection duct 700 ft. long which increases in diameter from 3 ft. to 7 ft. as it runs the length of the potline on its way to the dust collectors.

▶**Recovery of Solids**–Chief offender in the cell exhaust is fluorine, produced by thermal decomposition of the cryolite cell bath and by carbon tetrafluoride evolution during the anode reaction. But there's also a lot of dust in the exhaust gases–more than 35 tons per day, as a matter of fact. And this dust is worth recovering, too; it analyzes 80 percent alumina, 9 percent fluorides and 8 percent carbon.

Each of the 16 dust collectors consists of 300 9-in. diameter cyclone tubes contained in a chamber 13 by 18 by 22 ft. Kaiser engineers say that particles as small as 0.0002 in. are removed from the gas stream.

Each of the 16 300-hp. fans pulls 158,000 cfm., equivalent to more than 2,000 cfm. exhaust from each pot.

▶**Fume Scrubbers**–Discharge from each fan goes to a battery of four redwood scrubbing towers, each 10 ft. in diameter and 46 ft. high. Here the offending fluorine is washed from the gases by water sprays.

But another problem had to be licked by Kaiser engineers. In order to prevent stream pollution, they have installed a treatment plant for removing the fluorine from the scrubber effluent.

This unit consists of three mixing tanks 30 ft. in diameter and 14 ft. deep and a clarifier 125 ft. in diameter and 12 ft. deep. Lime is added in the mixing tanks, forming insoluble calcium fluoride. This is removed from the water as it goes through the clarifier. The sludge is pumped to a settling bed and the clear water overflow is recirculated to the scrubbing towers.

▶**Best of Three**—Recirculation of scrubber water is one of the major improvements Kaiser has made over similar fume disposal systems at its Tacoma and Chalmette works. Mead is also the only one of the three which collects the dry dust. Another feature of which the Mead designers are proud is the extensive manifolding of exhaust ducts. This has cut in four the number of fans per potline.

CONVENTION CALENDAR

Chemical Specialties Manufacturers Association, annual meeting, New Yorker Hotel, New York, December 7-9.

American Institute of Chemical Engineers, annual meeting, Cleveland and Carter Hotels, Cleveland, December 7-10.

American Pharmaceutical Manufacturers Association, midyear meeting, Waldorf-Astoria Hotel, New York, December 8-10.

Salesmen's Association of the American Chemical Industry, Christmas party, Waldorf-Astoria Hotel, New York, December 10.

Society of Cosmetic Chemists, semi-annual meeting, Biltmore Hotel, New York, December 11.

American Association for the Advancement of Science, annual meeting, St. Louis, December 26-31.

Plant Maintenance Conference, in conjunction with Plant Maintenance Show, Public Auditorium, Cleveland, January 19-22.

Society of Plastics Engineers, annual technical conference, Statler Hotel, Boston, January 21-23.

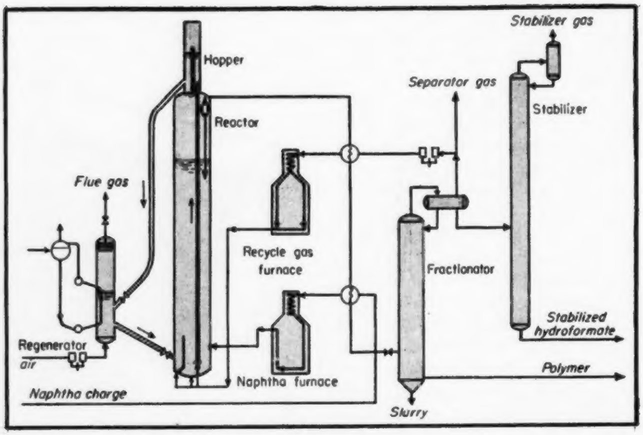
Commercial Chemical Development Association, Statler Hotel, Cleveland, January 22.

Association of Soap & Glycerine Producers, annual meeting, Waldorf-Astoria Hotel, New York, January 27-29.

American Pharmaceutical Manufacturers Association, eastern section meeting, Roosevelt Hotel, New York, February 2-4.

American Association of Textile Technologists, annual symposium, Statler Hotel, New York, February 3.

REACTOR going up at Destrehan.



PROCESS upgrades naphthas, is a big step in fluidization.

First Fluid Hydroformer Ready to Go

First commercial fluid hydroformer, a 2,000 bbl.-per-day unit, is scheduled to be in operation this month at Pan-Am Southern's Destrehan, La., refinery.

Hydroforming, now in wide use with fixed catalyst beds, is the conversion of low-octane naphtha into a high octane gasoline largely by means of dehydrogenation and cyclization reactions. M. W. Kellogg Co., which licenses hydroforming patents, did all the engineering and construction on the fluid plant.

▶**Old Catalyst First**—When this unit goes on stream, catalyst discarded from a commercial fixed-bed hydroformer will be used to start it up, scour it out, and give initial operating experience.

Although the fluid catalyst technique has been used for a good many years in catalytic cracking units, this is its first venture into hydroforming.

Here's how fluidization will improve this process:

- Lower investment and operating costs.
- Better yields of higher quality product.
- Simpler operation.

These advantages accrue from the continuous nature of the process, the more uniform catalyst temperature and distribution.

Here's how the process works:

First, naphtha and hydrogen-rich recycle gas are preheated by exchange against hot reactor effluent and then in furnaces (see *flowsheet*). Then these charge materials, together with regenerated fluid catalyst, enter the base of the reactor. The vapors rising through the reactor, fluidize the catalyst bed, then go through a catalyst disengaging space and two stages of cyclone separators.

▶**Then Fractionation**—After passing through the two exchangers, reactor effluent enters the fractionator near its base. Here, gasoline and a hydrogen-containing gas substantially free of hydrocarbons heavier than propane, are separated from higher boiling polymer. A small amount of catalyst slurry which has escaped the cyclones is returned from the fractionator bottom to the reactor.

Spent catalyst is lifted by recycle gas through a riser into the hopper at the top of the reactor (see *cut*). Here it is stripped with steam or recycle gas, then through a standpipe into the regenerator, and from the regenerator back into the base of the reactor.

▶**Carbon Burned Off Completely**—Regeneration is accomplished by complete combustion of the small amount of deposit. Excess heat is removed through vertical water tubes inside the regenerator and partly submerged in the fluid bed of catalyst. Steam is generated at approximately regenerator pressure to minimize leakage. Flue gas which leaves the bed passes through a disengaging space in the regenerator, then through ceramic filters to remove entrained catalyst; three of these ceramic filters operate while a fourth is being blown back with hot air.

▶**Process Control**—Pressure on the reactor can be kept at about 250 psig. by throttling the gas-vapor effluent; regenerator pressure at about 260 psig. by throttling the flue gas.

Regenerator temperature (about 1,100 deg. F.) is controlled by varying catalyst bed level to change the submergence of the water tubes.

Bed level in the regenerator is controlled by the slide valve in the regenerated catalyst standpipe. Bed level in the spent catalyst hopper is controlled by the slide valve in the spent catalyst standpipe.

Pressure drop across each of these slide valves is about 5 psi.

Bed level in the reactor is fixed by the catalyst inventory of the system. Rate of catalyst flow is adjusted by the plug valve and rate of gas injection used in the spent catalyst riser.

▶**Particle Size**—The catalyst itself is molybdena-on-alumina, containing about 10 percent MoO_3. The initial particle size distribution is about 5-10 percent finer than 20 microns; over 20 percent 20-40 microns; over 30 percent coarser than 80 microns.

This distribution is similar to commercial grades of fluid catalytic cracking catalyst. Attrition resistance of the molybdena-on-alumina catalyst is equal to or better than the more resistant grades of synthetic fluid cracking catalyst.

(*News continued*)

How can you know which tube steel is best for you? Ask the experts!

This month the Timken Company reports on:

16-13-3 STAINLESS

An austenitic, non-magnetic alloy. For temperatures up to 1500° F., it possesses greater creep and rupture strength than 18-8. Its oxidation resistance and corrosion resistance in hot petroleum products is of the same high magnitude as that of 18-8. It is recommended for use in those high temperature applications in which greater strength is required than can be obtained with 18-8 and where increased resistance to certain acids and salts is desired.

ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

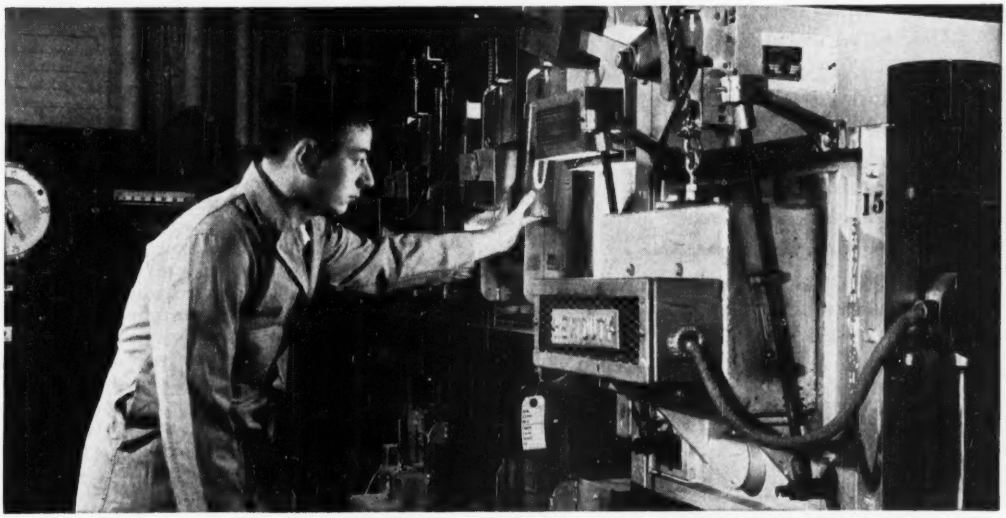
Carbon	Sicromo 2	Sicromo 5S	18-8 Ti
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20*
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6**

**Available as seamless tubing on an experimental basis only.*
***Not available as seamless tubing.*

THERE are probably several high temperature steels that are adaptable to your particular heat, pressure, oxidation and corrosion conditions. But there's only *one* steel that's best—the one that will give you maximum tube life per dollar.

To get the one tube steel that gives you the best life/cost ratio, whether it's one of 8 analyses of stainless or one of 16 other analyses, call on the Timken Company's metallurgists. They're recognized authorities on stainless and other high temperature steels. Backed by 25 years' experience in steel development they can help you select the one tube steel that's best for you. And no matter which analysis you select, you can be sure of uniform quality because the Timken Company rigidly controls quality from melt shop through final inspection.

Let Timken "RSQ"—Research, Supply, Quality—solve your tube problems. *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".



Exhaustive research is one reason for Timken's leadership in high temperature steels. Photo shows furnaces in the Timken Company's experimental heat treating laboratory.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

NEWS, *cont.* . . .

Constant Light Source Uses Tritium in Stilbene Crystal

Tritium, the extra-heavy hydrogen isotope produced in atomic reactors at Oak Ridge, is being used by Tracerlab Inc. of Boston to make a substantially constant light source.

Radioactive tritium is incorporated into stilbene, a crystalline substance, and processed chemically to form a solid crystal.

The tritium constantly gives off beta rays, causing the stilbene to fluoresce. The new crystals, according to Dr. Irving A. Berstein and Earle Farmer, the Tracerlab researchers who developed them, yield almost constant luminosity and yet have essentially no health hazards.

"Although light from the tritiated stilbene is visible to the eye," Berstein says, "the maximum light output is strongest in the region where the eye is least sensitive and where all phototubes are most sensitive.

"The new source, therefore, will be very useful for calibrating instruments, containing phototubes, which have to be standardized periodically," Berstein adds. "They will also be of value to astronomers and other scientists who need a constant light source for use in optical research."

Brightness diminishes at the rate of only about 5 percent each year. It is expected that such a new source will retain over 50 percent of its light output even after 10 years of use. Radium-activated sources now used lose half their light in about three to six months.

Other non-hazardous, tritiated, self-luminescent materials are now being developed that will be far more visible to the human eye. These materials, according to Berstein, will be useful for luminous markers, watch dials and other applications for which hazardous radium-activated substances are now used.

Kaiser Lifts Aluminum Output As Another Potline Operates

When the third potline went into operation recently at the Chalmette plant of Kaiser Aluminum & Chemical Corp. near New Orleans the nation's primary aluminum capacity was boosted by 50 million pounds a year.

A fourth potline is scheduled to go into operation this month. When the

plant reaches full production next year, eight potlines will be turning out aluminum at the rate of 1 million pounds a day. The Chalmette plant will have a capacity of 400 million pounds yearly.

Vitro Doubling Capacity For Milling Uranium Ore

Capacity of its uranium ore reduction mill south of Salt Lake City will be more than doubled by Vitro Chemical Co., subsidiary of Vitro Manufacturing Co. of Pittsburgh, Pa.

At the close of its first year of operation, the plant now mills about 165 tons of uranium ore per day. Plans are to expand the mill to a capacity of 350 tons per day of ore.

New Producer Will Extract Chlorophyll From Alfalfa

First plant in Minnesota designed for extraction of chlorophyll from alfalfa is now in production. It's the plant of Minnichlor, Inc., at Enfield, Minn., 50 mi. west of Minneapolis.

The firm is producing water-soluble chlorophyll, and expects to market it to large users on the East Coast. Among those contacted by Minnichlor are big toothpaste and drug manufacturers in the East.

A group of Minneapolis business men organized Minnichlor in February 1952. President and chairman is H. J. Sadler; research and development are directed by A. E. Sorenson, a stockholder.

Its location within trucking distance of the alfalfa belt reduces freight costs on raw material shipped to the plant. The new plant is on the main line of the Great Northern Railroad.

Purchased from the Enfield Cheese Co. in March of this year, the former cheese plant has been remodeled and fitted with equipment originated and designed by members of the firm. In appearance, the plant resembles a small petroleum refinery.

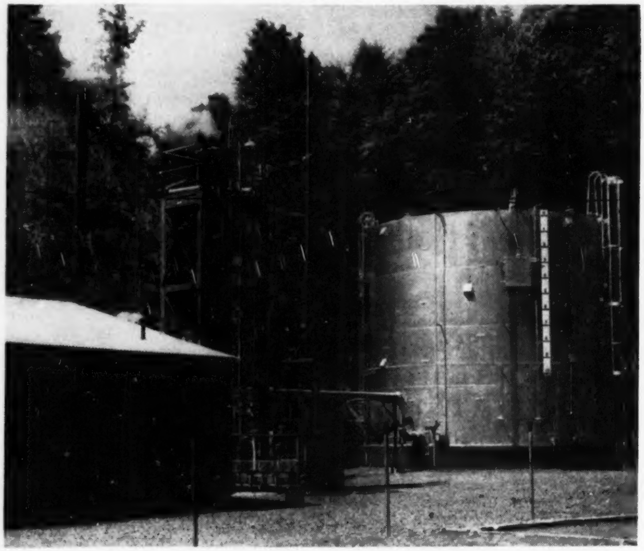
Dehydrated alfalfa is purchased by Minnichlor from dehydrating plants in the area. By weight, this meal is one-third to one-fifth of the original green crop alfalfa.

From a ton of the meal, Minnichlor extracts four to six pounds of chlorophyll, at a current market value of $85 to $105 per pound, depending on its purity. The firm will produce chlorophyll in different purity percentages to meet varying com-

mercial requirements. By January 1953, Sadler says, the company will produce 75 to 100 pounds of chlorophyll per day.

This extraction process is believed to be original. After comparing size and output of competitive eastern plants, Sadler believes Minnichlor has evolved important short-cuts in extraction.

In addition to chlorophyll, byproducts of extraction will also be marketed. These include carotene, xanthophyll, phytol, other vegetable fats and spent meal. Carotene is a source of vitamin A, and phytol of vitamin E. The vitamins will be sold to food and drug companies.



RECOVERY UNIT: Boiler house where waste H_2S from carbon bisulphide manufacture is burned; scrubber recovers the sulphur; tank holds 10,000 cu. ft. of H_2S.

Getting More CS_2 From Sulphur

In the production of carbon bisulphide at its Penn Yan, N. Y., plant, J. T. Baker Chemical Co. will recover sulphur from the waste gases formed during the manufacturing process and use it over again to make more bisulphide. A new unit there will get back about 1.25 million pounds per year of sulphur.

Waste gases, principally hydrogen sulphide, are mixed with air under pressure and burned in a boiler. The mixture then passes over a catalyst bed to accelerate the reaction between oxygen and hydrogen sulphide, producing a hot, gaseous mixture of sulphur and water.

This combination next goes through a scrubber, where molten sulphur, introduced countercurrently, cools and absorbs the gaseous sulphur. The absorbed sulphur is returned to the electrothermal furnace for immediate reuse.

The Penn Yan plant is unique in that it was the first to produce carbon bisulphide commercially by the electrothermal process–in which molten sulphur and lump charcoal are reacted within a huge electric furnace (see *Chem. Eng.*, Jan. 1951, p. 174).

Baker recently erected a new \$100,000 electrothermal furnace, an addition to the three others in use. It also installed underwater storage facilities and handling equipment to increase efficiency and insure worker's safety.

The expansion at Penn Yan is part of Baker's \$3 million modernization program started in 1950 and scheduled for completion this year. The company's main plant is at Phillipsburg, N. J.

(News continued)

Ways Sought to Dispose of Semi-Chemical Pulping Waste

Finding cheaper ways to evaporate or to concentrate the spent liquor from the neutral sulphite process has been the goal of research during the last six months at Virginia Polytechnic Institute and Louisiana State University on the waste handling problems in semi-chemical pulping.

Three processes were investigated. They were submerged combustion evaporation, vapor compression evaporation and selective solvent concentration.

Capital cost for submerged combustion evaporation, it was found, is much lower than that for conventional evaporators. But fuel requirements are substantially higher and limited to gas for fuel.

Vapor compression evaporation operates with considerably higher efficiency. However, it is much higher in equipment cost than other methods.

Selective solvent concentration with acetone is costly due to the volume of acetone that has to be separated by distillation for recycling.

The heat hydrolysis process was also tried at Virginia Polytechnic. It is less effective on semi-chemical liquor than on acid sulphite. This is because semi-chemical liquor contains little hexose and is neutral in reaction.

Sulphuric for Triple Super To Come From Zinc Maker

A new zinc roasting and sulphuric acid plant that Eagle-Picher Co. is building near Galena, Kan., will produce about 240 tons of sulphuric per day. The $4 million plant will be completed early in 1954.

Most of the acid will be sold by Eagle-Picher under long-term contract to the Missouri Farmers Association, which will erect a plant at Galena to produce triple superphosphate via wet-process phosphoric acid.

Mexican Crude: Mexico will produce more than 80 million barrels of crude oil this year, according to officials of Petroleos Mexicanos. This is more than double production in 1943, when only 35 million barrels were produced.

Polyester Resins: The Naugatuck Chemical Division of U. S. Rubber

Co. is doubling capacity for polyester resins at its Naugatuck, Conn., plant. Polyester resins are used increasingly to reinforce glass fiber. Demand has climbed in the last year, especially for use in chemical-resistant pipe, translucent and transparent sheeting, machine housings, materials handling equipment and plastic parts for the aircraft, boat and auto industries.

Methylamines: Commercial Solvents Corp. has been awarded a certificate of necessity for $4.3 million by DPA for expansion of its plant at Sterlington, La. The expansion will add capacity for production of methylamines.

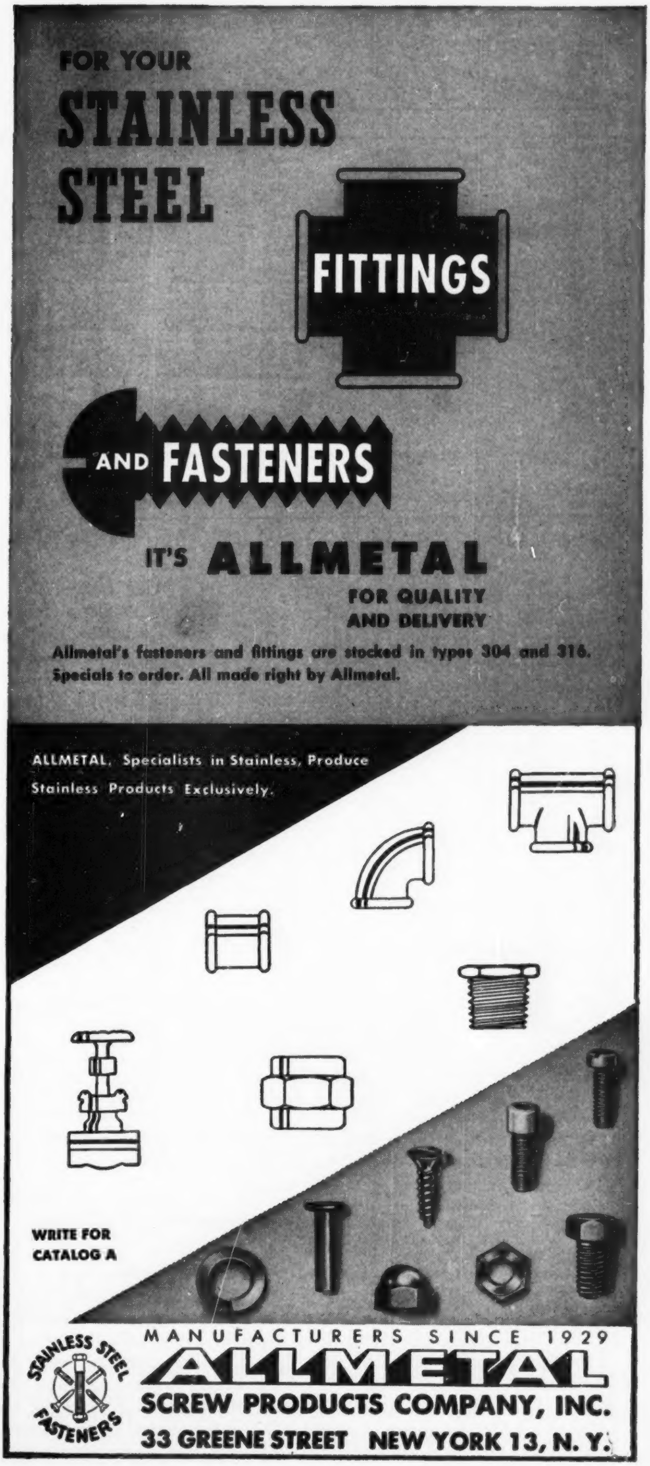
Germanium: Coal may become a source of germanium, the scarce metal that goes into transistors, the new electronic devices that do the work of vacuum tubes. Pennsylvania Coke & Coal Corp. will assay coal samples sent in by coal operators all over the Appalachian coal region for germanium. If a method of extracting germanium from coal is devised, it will add to the value of coal. Germanium sells today for $350 a lb.

Dioctyl Phthalate: Monsanto Chemical Co. is now producing dioctyl phthalate in a new unit at its Everett, Mass., plant. Phthalic anhydride, raw material for DOP production, is manufactured in an adjoining unit at Everett. The expansion will meet growing demand in the East for this plasticizer.

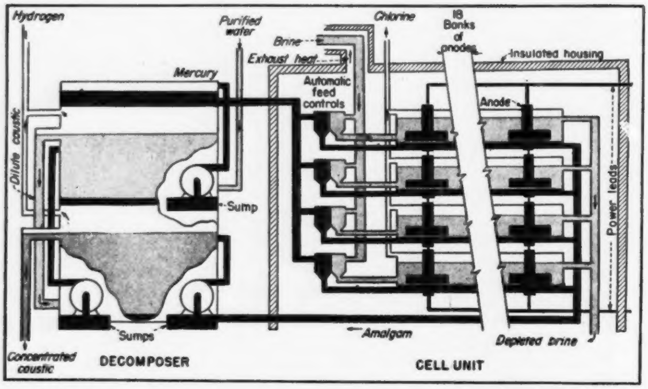
Cat Cracker: At a cost exceeding $20 million, Standard Oil Co. of California will build a catalytic cracking unit at its El Segundo, Calif., refinery. The cracker will convert heavy fuel oil into aviation gasoline and high-grade automotive fuels. Its capacity: 36,000 bbl. daily.

Barite Goal: DPA has called for annual production of 1,360,000 short tons of barite ore by 1955. This comprises about 1 million short tons of drilling grade and 360,000 tons of chemical grade. The goal represents an increase above 1951 of 420,000 short tons of drilling grade and 40,000 tons of chemical grade. Drilling-grade barite is a mud used in drilling oil wells.

—*End*



Readers' Views & Comments



Stacked Cells: Short Circuit?

Sir:

Perhaps I've missed something, but in your drawing on p. 265 of your July issue it looks as though the amalgam lines short circuit the current around the vertical series of cells.

Is this incorrect?

G. F. Quittner
Assistant Chief Chemist
Industrial Rayon Corp.
Painesville, Ohio

▶ *Reader Quittner refers to our July story on the development of vertically stacked chlorine cells by A. S. White of Chicago. For Inventor White's answer, see the letter that follows.*—Ed.

Stacked Cells: New Bonus

Sir:

It is true, as Mr. Quittner points out, that the drawing seems to show a short-circuit current around the vertical series, but this is incorrect.

Actually the cell is isolated electrically at both feed and discharge ends, as indicated in the text of the story. I have applied for an additional patent on this new type of circuit breaker, also of my design. Perhaps the feed and discharge lines could have been shown broken, but this would serve no real purpose. I felt it best not to show details in the drawing.

There is no transfer of current from cell to decomposer in my cell as there has been in other cells over the past 60-odd years. This fact has led to an interesting bonus which my associates and I have worked out since publication of the article in *Chemical Engineering.*

We find that an isolated decomposer will act as a simple galvanic cell to generate a sizable amperage at about 2.7 volts. A series-parallel hookup of the decomposers in a plant will generate 15,000 amp. at 8.1 v.—a bonus of 2.5 tons of chlorine with no power cost!

I am sure your readers see now why I haven't yet felt free to give out all details of my cell. . . .

A. S. White
7344 S. Green St.
Chicago 21, Ill.

▶ *Our short story on the White vertically-stacked chlorine cell sparked immediate and widespread interest in the electrochemical industries; we're still getting inquiries from all over the world.*

As one well-known consultant in the chlor-alkali field summed it up: "The vertical or stacked chlorine cell is bound to come sooner or later. Is White's setup the answer? Naturally we don't know yet, but he has certainly made a move in the right direction." We have learned that several firms have also done or are doing experimental work along the same lines.—Ed.

Underground LPG Storage

Sir:

In your September issue (p. 354) you discuss the storage of liquefied petroleum gas by the General Gas Corp. in underground reservoirs. It is stated in brief that the stored LPG is reclaimed by pumping "fresh" water into the cavity to displace the LPG. This is the method as we understand it, except that we believe a saturated solution of salt water is used, rather than fresh, as the displacement medium.

It is our belief that the salt water originally displaced by the LPG is held in a convenient pond and used again when the LPG gas is to be recovered. By introducing salt water instead of fresh water you do not enlarge the storage cavity by dissolving more salt.

John V. Grimaldi
Assistant Manager
Accident Prevention Dept.
Association of Casualty & Surety Cos.
New York, N. Y.

▶ *Your understanding is correct. General Gas does use salt water and not fresh water to reclaim stored LPG. During the recovery process, salt water is pumped into the cavity for eight hours; fresh water is then pumped in to clear pumps and tubing of salt adherents.*—Ed.

An Answer for 318

Sir:

I should like to compliment you on the excellence and timeliness of Julian C. Smith's chemical engineering report on "Size Reduction" in the August (p. 151) issue of *Chemical Engineering.*

Are reprints available of this report . . .?

Clayton V. French
Johns-Manville Research Center
Manville, N. J.

▶ *To Reader French and the 317 other readers who have asked us the same question within the past two months:*

Yes, reprints of this 16-p. report are available at 50 cents each. Ask for Reprint 25.—Ed.

Security Was a Snare Then, Too

Sir:

In your editorial "Security Can Be a Snare," in the issue of August, 1952, I think you overlooked one important item—the plight of the "white collar" worker, whose payrate compares adversely with that of mechanics.

When I was taken out of high school in my sophomore year, back in 1906, to go to work, a number of boys of my age sought employment in the offices of various railroad companies. *(Continued)*

The argument in favor of these office jobs was "Easy work, short hours, steady employment for life, Saturday afternoons and holidays off, two weeks vacation each year with pay, and a free pass on the railroad for a vacation trip." The starting pay averaged \$25 per month with a \$10 raise each year until they reached \$75, then a \$5 raise each year to \$90. Advances above this rate were slow, and not necessarily for everyone.

Being big and husky for my age, I found that I could start in as a mechanic's helper at \$2.50 per day. Here I was only paid for the days that I actually worked. However, I earned considerable overtime, so that I could take two weeks off for vacation and pay all my vacation expenses, including the two weeks loss of pay out of my overtime.

Over a period of several years, I worked on outside construction jobs in the mountains. Here I could have hunting and fishing throughout the open seasons, without the necessity of making an expensive vacation trip. Also, on this work, I wore work clothes, which were far less expensive than those required for office work.

When I left high school, it was my ambition to return some day and then go to college for an engineering course.

Here I ran into another argument. People would say, "What is the use of spending eight years in high school and college when you can take a business college course in six months and they guarantee to get you a job when you complete the course." As this kind of work did not appeal to me, I left it alone. Also, I found that these jobs averaged much less than I was making in overalls. There were so many clerical workers being turned out by the business courses and so many willing to take low wages to work in an office, that on the whole it was not an encouraging outlook.

Another factor entered at this point. To get a white collar job, a boy had to dress up, sit in the outer office until called in, stand with his hat in his hand until told to be seated. He was then asked for references, examined like a suspected criminal, and grudgingly hired if there was an opening. Usually, several were examined for one actually hired. Once hired, he was subjected to a certain amount of abuse, and if he quit the boss could

make trouble by refusing to recommend him at the next place he applied. Some employers refused to interview a man without references.

On the other hand, I could walk into a machine shop, a power plant, or a construction job in work clothes, ask to see the boss and be treated like a man. If the boss sized me up favorably, I was told to take off my coat and start in. The boss didn't care anything about my previous history. He started me in from scratch and let me write my own ticket. If I didn't like the job I could quit, and if the boss wasn't satisfied he fired me, but when I left he was through and he didn't follow me onto the next job and put me in bad there. His attitude was that a man might not suit him but he might be a first class man on another job and if so, good for him.

Ultimately, I went back and finished high school and then took a four-year mechanical engineering course at the University of California. My previous employers had found my work satisfactory, so they had a job waiting for me every vacation to earn college expense money. I was four years over the average age when I graduated, in 1915, but I still think that it was worth the effort.

Between two business depressions and serving the army during World War I, I have not made the progress that I would have expected to under normal conditions.

But nothing worth having comes easy, and I would like to dump overboard all the security and fringe benefits and take a job where I can stand on my own feet and work my own way up. As I told the first man I applied to when I left the army in 1919, "I am looking for a job where I can get fired."

A man holding a job with too many security benefits is not a free man. Back in 1905, when a man wanted such a job, he was not looked on as a working man; he was very apt to be called a "bum."

Howard T. Livingston
Los Angeles, Calif.

▶ *We appreciate these interesting snatches from the early life of Reader Livingston; we admire his staunch and independent spirit: "Nothing worth having comes easy, and I would like to dump overboard all the security and fringe benefits and take a job where I can stand on my own feet . . . a job where I can get fired. . . ."*

And we like his neat summary of the moral of our editorial: "A man holding a job with too many security benefits is not a free man."—Ed.

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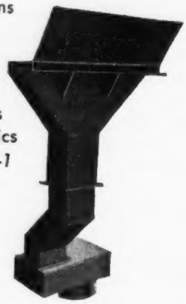
- Special Techniques in Fabrication
- Range of Fabrications
- Broad Range of Properties
- Applications in Industry
- Resistance Properties
- Physical Characteristics

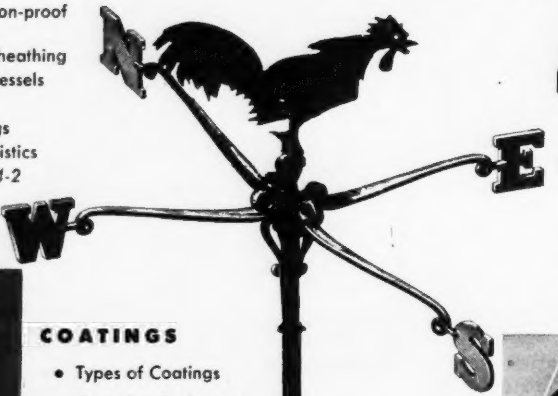
Write for Bulletin 9-1



LININGS

- The Need for Corrosion-proof Linings
- The Need for Brick Sheathing
- Protection of Steel Vessels
- Concrete Tanks
- The Four Basic Linings
- Resistance Characteristics

Write for Bulletin 4-2



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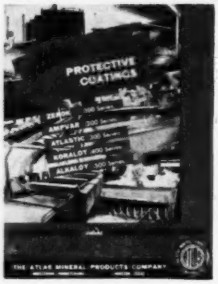
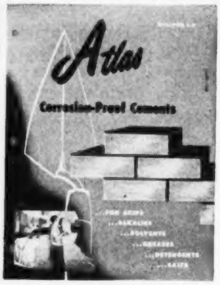
...self-supporting material for corrosion-proof construction



COATINGS

- Types of Coatings
- Corrosion Resistance
- Use of Primers
- Surface Preparation
- Methods of Application

Write for Bulletin 7-1



CEMENTS

- Requirements of Corrosion-proof Cements
- Choosing the Proper Cement
- Characteristics of the Four Basic Cements
- Resistance Characteristics
- The Function of Brick and Cement
- Principal Constructions of Brick and Cement
- Floor Constructions
- Estimating Tables

Write for Bulletin 5-2

ATLAS encompasses all four phases of corrosion-proof construction

Just as there is no universal solvent, there is no universally applicable material of corrosion-proof construction for the process industries. The corrosives involved as well as economic factors require consideration of all four categories of corrosion protection . . . all standard ATLAS products.

These factual bulletins eliminate confusion and guesswork in choosing the proper materials . . . they should be in your reference files.

ATLAS PRODUCTS STAND
. . . between your process and corrosion

Corrosion-proof: Cements . . . Coatings . . . Vessel Linings . . . AMPCOFLEX®

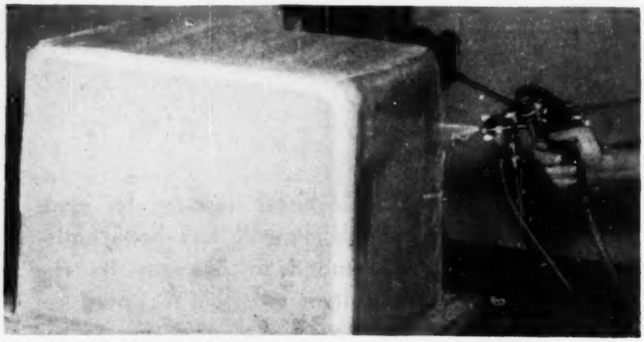
. . . WHATEVER DIRECTION YOUR REQUIREMENTS TAKE

ATLAS engineers can be of impartial assistance in presenting the facts . . . since all are standard ATLAS products.

ATLAS MINERAL PRODUCTS COMPANY
MERTZTOWN PENNSYLVANIA
HOUSTON TEXAS

45 Chestnut Street, Mertztown, Pa.


If better valves
could be made,
POWELL would make them
This is no idle boast because, for more than a century, Powell has been satisfying the demands of industry for the best valves it is possible to produce. As a result, Powell Valves have an enviable reputation for dependable service, long life and minimum maintenance.
The Wm. Powell Company
Cincinnati 22, Ohio
Fig. 2491.—Stainless Steel O. S. & Y. Gate Valve for 150 pounds W. P. Available in a variety of other corrosion-resisting metals and alloys. Also made with screwed ends.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846



Processing step in the manufacture of a Fiberglas-reinforced polyester tank. Note catalyst and liquid resin are being mixed in the nozzle of the spray gun.

Reinforced Polyester Plastics

The corrosion resistance of these materials of construction to a number of corrosives, with physical properties, forms available, and applications.

RAYMOND B. SEYMOUR & ROBERT H. STEINER
The Atlas Mineral Products Co., Mertztown, Pa.

The so-called polyester resins are based essentially on solutions of unsaturated linear alkyd-type polymers dissolved in a polymerizable monomer, such as styrene. The final plastic product is prepared by curing the liquid resinous solution with selected catalyst systems. A typical polyester resin may be prepared from maleic anhydride and ethylene glycol. Such products should not be confused with saturated 100 percent polyester resins which are made from non-reactive dibasic acids, such as phthalic acid and saturated glycols.

There are, of course, many variations in formulation possible. But commercially-available unsaturated polyester resins, when completely cured, have similar chemical resistance. Care should be taken to ascertain that only chemically-resistant polyester plastics are used for corrosion-resistant construction.

Polyester plastics especially compounded to secure specific properties, such as flexibility, usually have inferior chemical resistance. Likewise, products not designed for chemical end use may contain non-resistant fillers, such as calcium carbonate. However, polyester resins designed for maximum chemical resistance may be used as coatings, cements, and in combination with glass mat or woven glass fibers. They will give adequate service when proper recognition is given to the limitations of such materials.

Since the major use of unsaturated polyester plastics is as a low-pressure glass fibre laminate, the physical and chemical properties outlined will be based on a typical product of this type. Thus, while the polyester resin itself is not affected by hydrofluoric acid, the accompanying charts will show the effect of hydrofluoric acid on the polyester glass fiber laminate rather than on the resin itself.

Polyester glass-reinforced laminated structures are available as tanks, tank covers, fume hoods, pipes, ducts, and various tailor-made equipment. The design depends on the ultimate use which may vary from a small photographic developing tray to a 10,000 gal. crude oil storage tank.

Polyester tanks or pipes may be made in the field through the use of compositions that cure at ordinary temperatures, but best results are secured with factory-made equipment. However, satisfactory results are usually secured when room temperature curing compositions are used to assemble, modify or repair prefabricated equipment in the field. Woven Fiberglass impregnated with room temperature-curing polyester resins have been used for field repair of many different types of objects such as cast iron pipe and steel tanks.

Ultimate temperature limitation of a reinforced polyester resin depends to a large extent on composition—but most commercially available formulations are not affected by temperatures as high as 300° F. These products are generally resistant to non-oxidizing acids, corrosive salts, and weak alkalis. They are satisfactory for some alcohols, formaldehyde, refinery crudes and gasoline but are not suitable for chlorinated solvents or strong alkaline solutions.

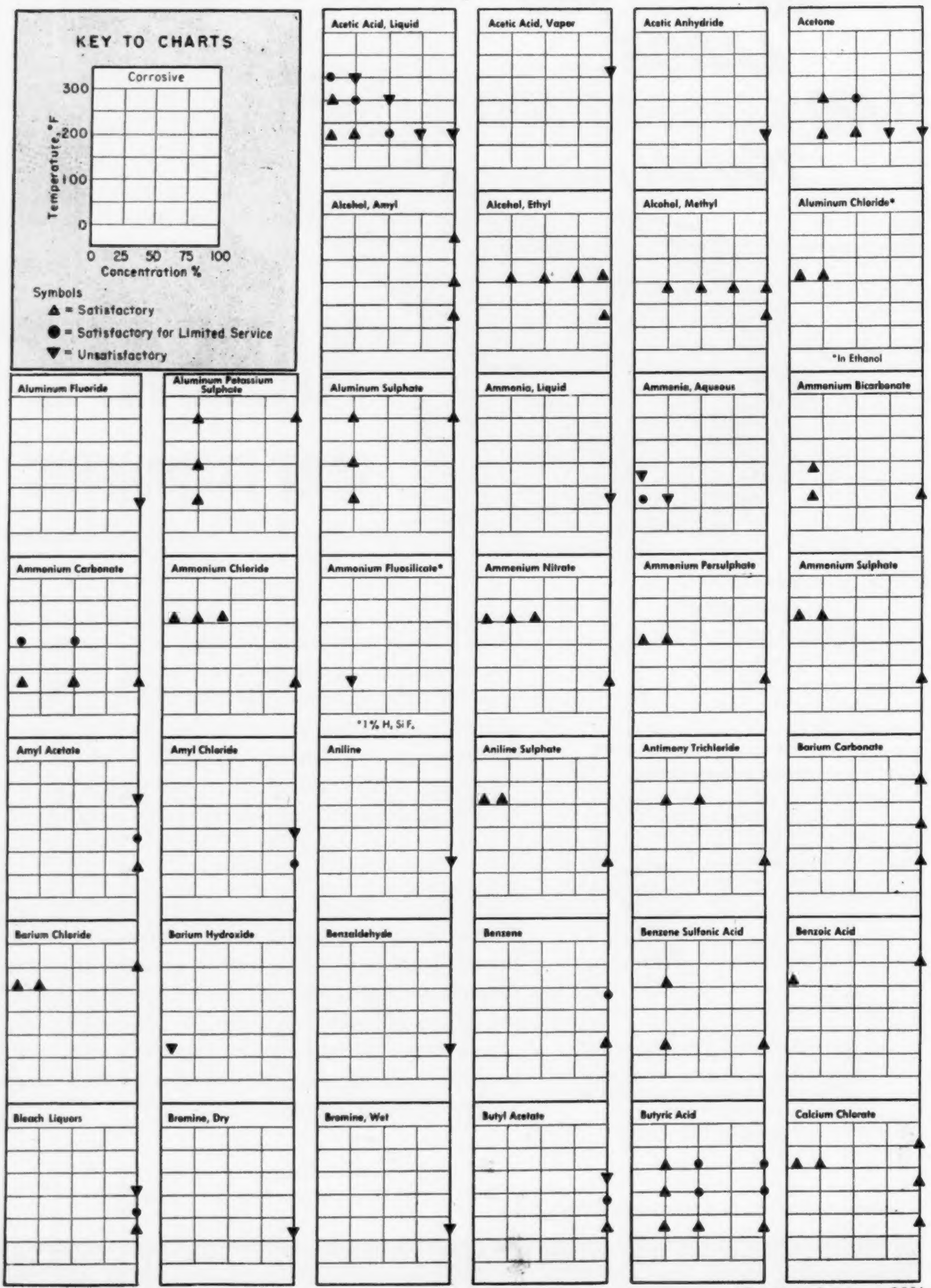
Unlike corrosion resistant metals which are attacked at a specific rate, plastics usually are either attacked very rapidly or practically not at all. Whenever a polyester plastic is shown to be satisfactory at a specific temperature and concentration, it may be considered satisfactory for all lower temperatures and lower concentrations for this specific corrosive. There is, of course, danger in generalization and while the charts will permit screening of various materials of construction, some knowledge of corrosion resistant plastics and the actual conditions of use is essential for the final selection of a corrosion resistant product.

On the charts that follow, the concentrations are actual concentrations. 100 percent concentration means 100 percent solid or 100 percent liquid as the case may be.

Mechanical and Physical Properties of a Typical Fiberglas-Reinforced Polyester Resin

Tensile strength, lb./sq. in. @ 75° F.	10,000
Impact resistance, Izod	10-35 ft.-lb./in. of notch
Hardness, Rockwell	M 90-M 110
Flexural strength, lb./sq. in.	20,000-60,000
Compressive strength, lb./sq. in.	30-60,000
Modulus of elasticity ($\times 10^5$ lb./sq. in.)	10.28
Specific gravity	1.5-2.1
Specific heat, btu./(lb.) (°F.)	0.2-0.25

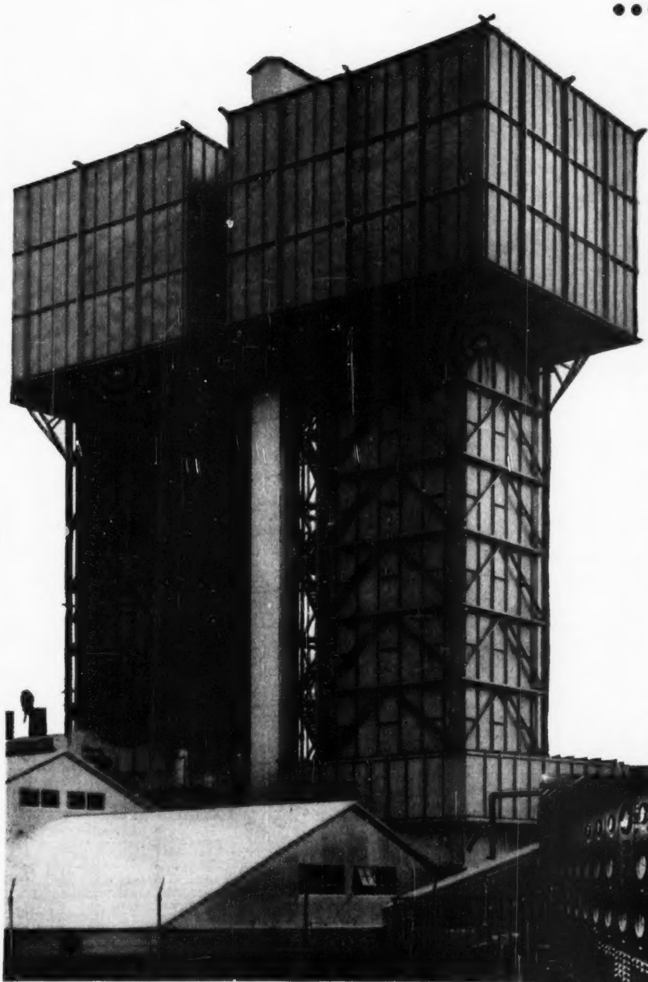
Corrosion Resistance of Reinforced Polyester Plastics



(Continued on page 282)

Spencer's Mammoth New Prilling Plant Goes "On Stream" without a hitch...

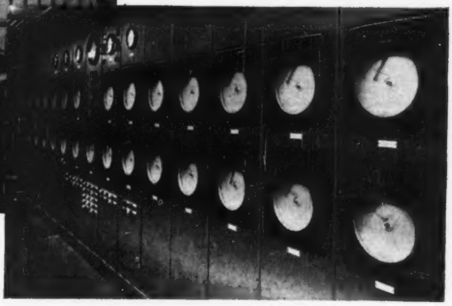
...thanks to Foxboro M-40 Controllers



The world's-largest ammonium nitrate prilling plant, at Pittsburg, Kansas, went "on stream" with complete freedom from major difficulties or redesigning. The Spencer Chemical Company gives credit to the precise control and extreme sensitivity of Foxboro M-40 Controllers. Moreover, this automatic process now has performed continuously and dependably for a year and a half with negligible instrument maintenance.

This is more proof that the M-40 brings process variables *directly* to their control points . . . meets pre-set values exactly . . . holds them there, continuously. Proof, too, that the Foxboro M-40 Controller — incorporating the most advanced developments in the field of pneumatic instrument design — is your soundest instrument investment. Available for temperature, pressure, flow, level, and other applications.

Write for details. The Foxboro Company, 3612 Neponset Ave., Foxboro, Mass., U.S.A.



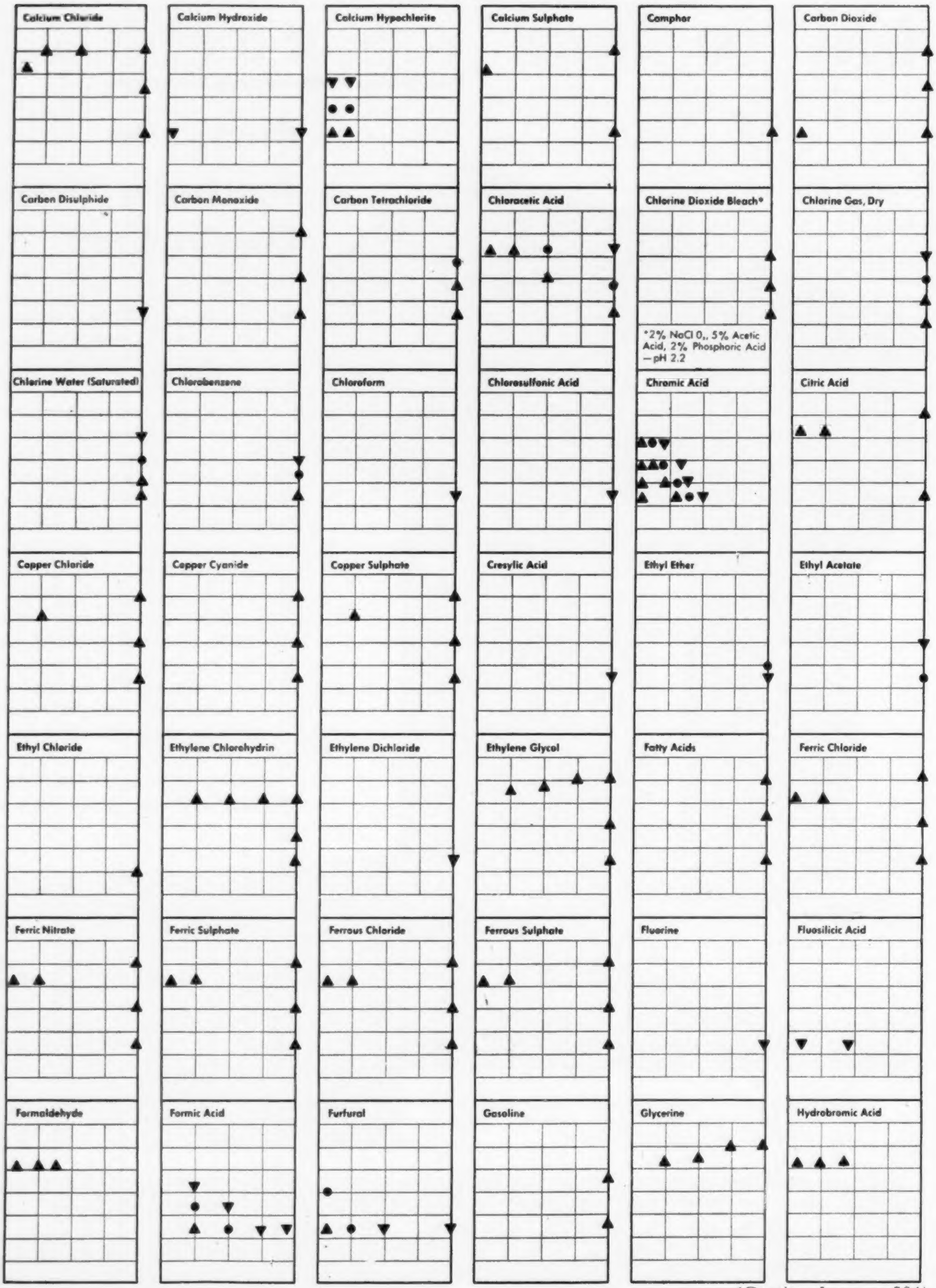
Central control room at Spencer Chemical's ultra-modern ammonium nitrate prilling plant, Pittsburg, Kansas, facilitates changing control settings . . . reduces operating personnel.

FOXBORO M-40 CONTROLLERS

REG. U. S. PAT. OFF.

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

Corrosion Resistance of Reinforced Polyester Plastics, *cont* . . .



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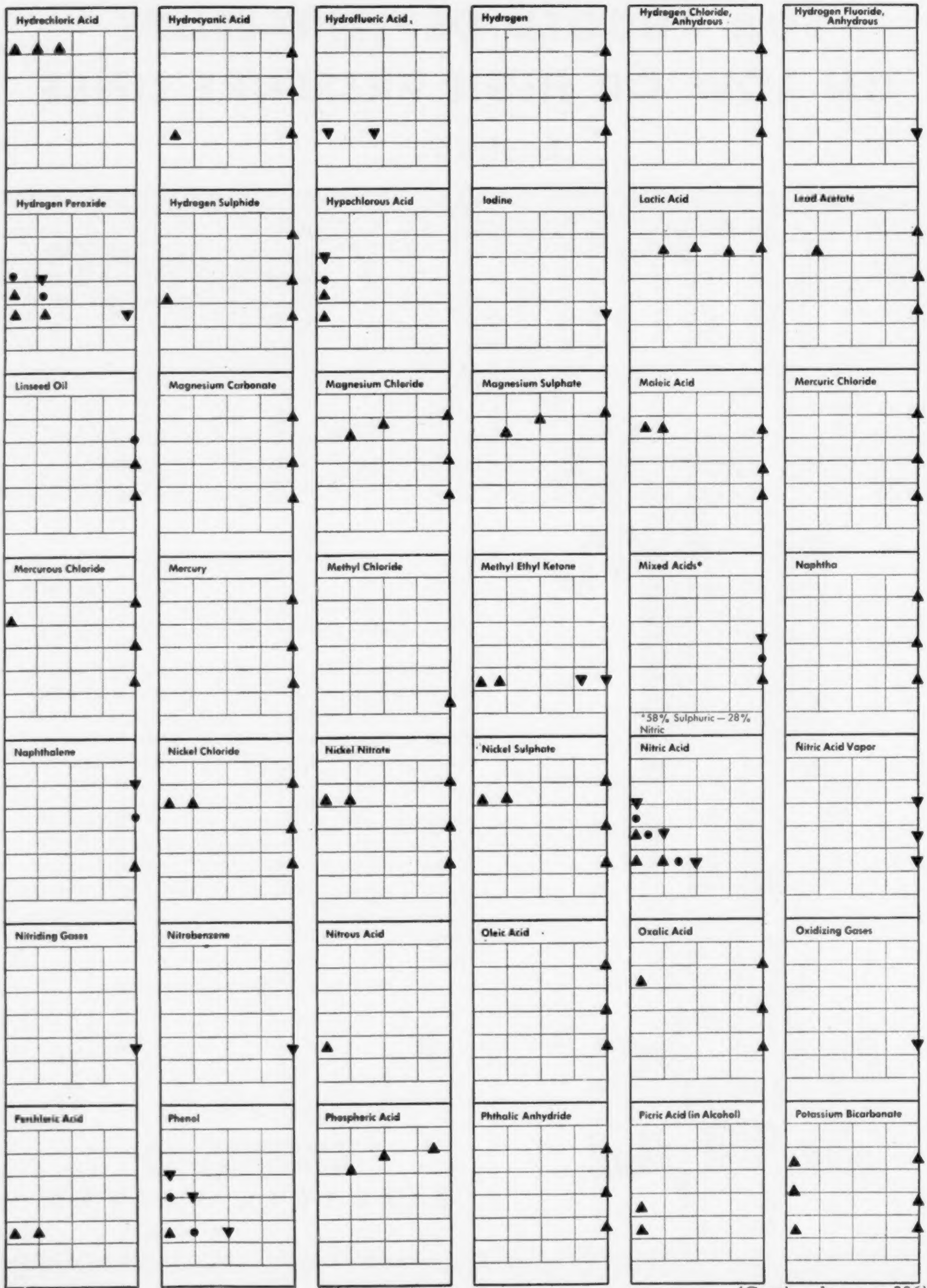
Corrosion Resistance of Reinforced Polyester Plastics, *cont . . .*



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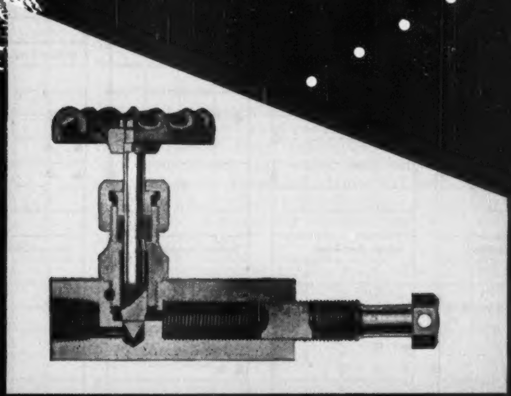
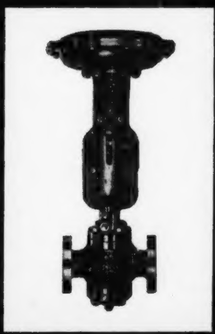
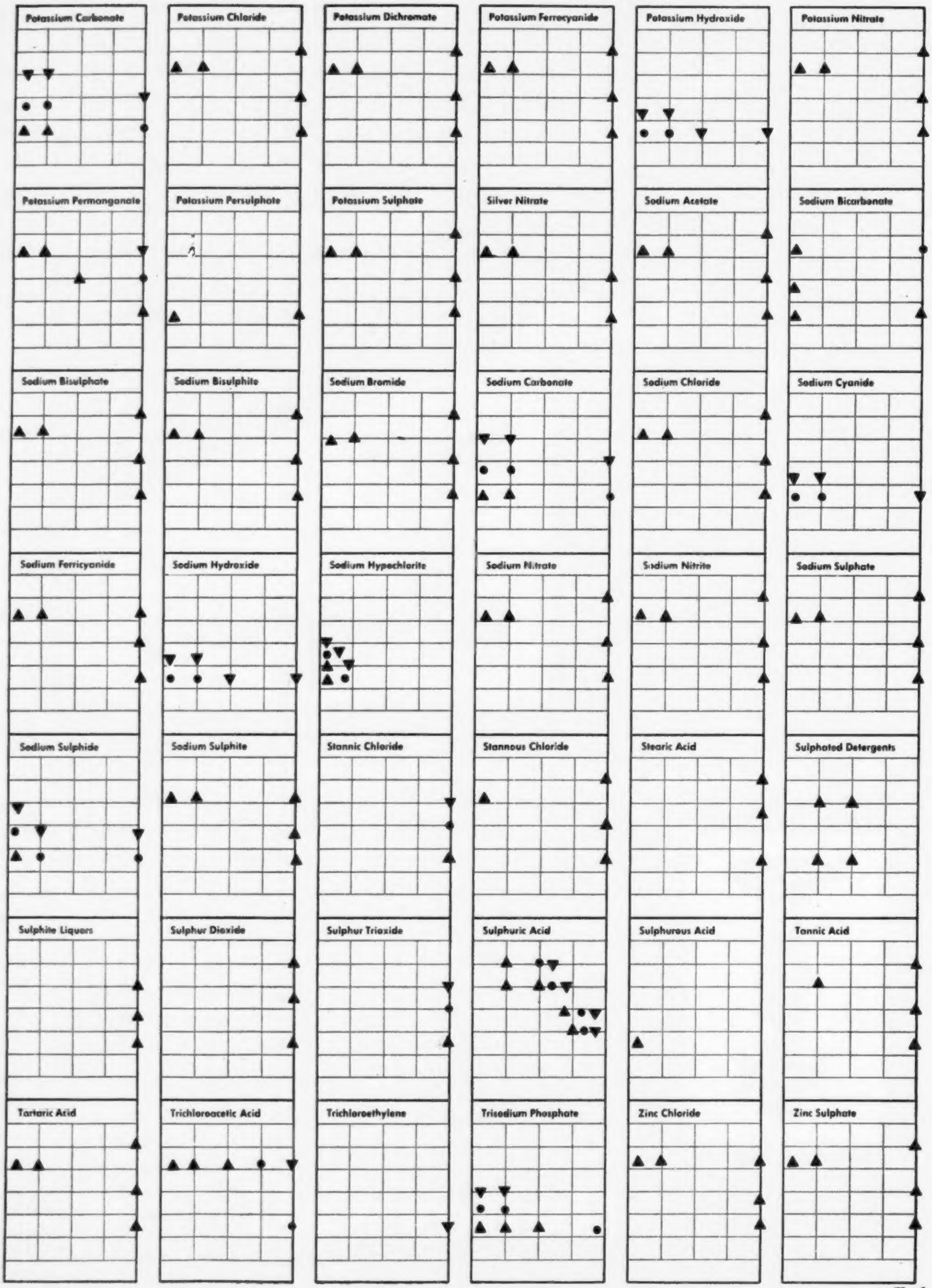




Corrosion Resistance of Reinforced Polyester Plastics, *cont . . .*

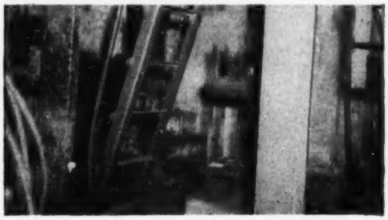


—*End*

CANCEROUS CORROSION STOPPED COLD!

These photos* tell the story — PRUFCOAT AS GOOD AS NEW 14 MONTHS AFTER APPLICATION

1. Here's a nutshell demonstration of the superiority of the simple "Prime and Paint" procedure made possible by new Prufcoat Primer P-50. The guard rail in the foreground got routine wire-brushing and scraping, a coat of Prufcoat Primer P-50, and then top coats of Prufcoat "A" Series Vinyl Coating. The mixing tanks in the background got conventional coating treatment. Compare the condition of the coatings after 14 months of service!



2. No sign of peeling or other failure, yet this Prufcoat primed and painted steel ladder and girder have been continuously subjected to corrosive sodium hypochlorite fumes for more than a year. With previous paint systems, in a matter of weeks, mere vibrations in the plant were sufficient to release large scales and sheets of rust.
*Photographs courtesy Kuehne Chemical Co. Elizabeth, N. J.

New Prufcoat Primer P-50 Licks Vicious Underfilm Corrosion Caused by Sodium Hypochlorite Fumes

Fumes generated in the manufacture of sodium hypochlorite were attacking every steel surface in the Kuehne Chemical Company plant. To make matters even more disastrous, there didn't appear to be a paint system available that could control the cancerous condition. Underfilm corrosion developed quickly, rust creepage was continual, and the most meticulously applied coatings failed in a matter of weeks.

"We knew our problem was a tough one," says the manufacturer's maintenance chief, "but felt that the vinyls, with their superior chemical resistance, could provide the protection we needed. Only trouble was, where could we find an inhibitive primer that would both stop the existing active corrosion on the metal *and* which vinyl coatings would adhere to. We're glad to report that Prufcoat Primer P-50 has filled the bill . . . without any sandblasting or other fancy preparation work, too!"

The photographs on this page offer dramatic and conclusive proof that Prufcoat did, indeed, "fill the bill". Applied to vats, motors, and other exposed steel surfaces according to the simple Prufcoat "Prime and Paint" procedure, the Prufcoat "A" Series Vinyl top coats with Prufcoat Primer P-50 underneath are virtually as good as new *more than a year later* — no peeling, no underfilm corrosion, no coating failure in sight!

What worked for Kuehne Chemical Company will work for *you* . . . in *your* plant . . . under *your* corrosive conditions. Prove that Prufcoat has the answer to your painting problems by writing for the facts today.

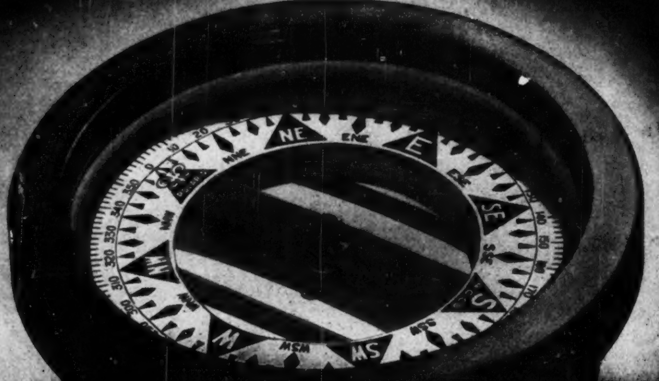
How Prufcoat Primer P-50 makes it possible to apply vinyl coatings like ordinary paints

No longer need vinyl coatings be considered in a "specialty" category. Thanks to new Prufcoat Primer P-50, vinyls are now as easy to apply as ordinary paints. After only routine wire-brushing, simply prime with ready-mixed P-50 just as you would with red lead. Vinyl top coats then can be applied after only overnight drying.

Primer P-50 bonds securely to any new or old metal surface, inhibiting underfilm corrosion which so frequently causes premature failures. In addition, its special nature guarantees firm adhesion of all top coats whether vinyl or conventional type. Here at last is one easy, sure-fire priming system for *all* paints . . . *all* metal surfaces.

PRUFCOAT LABORATORIES, INC.
50 East 42nd Street, New York 17, N. Y.

To Save Time, Trouble and Money.. Just "PRIME and PAINT" with PRUFCOAT



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You and Your Job *Edited by Richard V. Reeves*

How to Live With the Shortage of Engineers

Here, crystallized, are the facts telling how the employers of 106,000 engineers are learning to do without the 19,000 additional men they need — but won't get.

For those many companies which will be operating next year with fewer engineers but don't quite know how, the National Society of Professional Engineers has just come up with a recipe based on the results of a comprehensive, nationwide survey.

▶ **Who Were Surveyed and Why**—The society went to over 495 employers of some 106,000 engineers in 3,948 plants with questionnaires and personal inquiries. The idea was to find the best methods and procedures for keeping an engineering staff hitting on all cylinders and to publish such information for the guidance of companies who will have to make three engineers do the work of four next year.

▶ **Today's Demand Isn't Temporary**—This was one of the first pieces of information the survey turned up. More than 65 percent of the participating companies reported that they had a serious need for engineers, a need which they were unable to fill at the present time. These companies estimated that they would need about 11,000 engineers in the fall of 1952, and that if these needs were met they would require an additional 8,000 by spring, 1953. While these needs were spurred somewhat by the defense effort, to a greater degree the problem was one of the increasing man-hours needed to maintain our mode of living in a society where engineers figure in our food, clothing, shelter, protection, transportation, entertainment —and almost everything else.

▶ **Room for Improvement**—The study also turned up these facts. First, about 85 percent of the 106,000 engineers spend three-quarters of their time in technical engineering work. The potential of these for increased responsibility is generally rated "good" or higher. Second, about 70 percent of the companies in the study stated that they did use graduate engineers for non-technical work—sales, customer relations, non-engineering executive duties and the like. Seventy percent of the companies also reported using supporting personnel to relieve their staffs of routine engineering detail.

But here's the meat of the study—how the society spells out the "How To" of better utilization of today's engineering manpower.

1. How to Make New Employees More Effective

▶ **Indoctrination Is Important**—An earlier study by NSPE showed that 56 percent of the firms covered, had no formal training programs for newly-hired graduates; 66 percent had no indoctrination programs for newly-hired experienced engineers. Yet it was generally conceded that selection and training is more important now than ever before. Personnel men emphasize that good men need special training to reach, quickly, their own level, direction and pace of work. Lesser candidates, in whom an investment is to be made, will pay off more quickly if the trainers know their strengths and weaknesses, and develop in them the proper capabilities.

Another factor considered is that training programs make it possible to eliminate misfits from the company before they can become a major item of expense and failure.

▶ **The Work Indoctrination Programs**—These are divided roughly into two classes, the first for recent grads, the

14 PROVOCATIVE QUESTIONS . . .

1. What jobs or tasks are you now performing which could be turned over to technical specialists? Please give specific details.

2. Are there any of your duties which could be simplified so that part or most of them could be turned over to subordinates?

3. Is there any of your administrative detail work which could be done by non-engineers or competent secretaries?

4. Can you suggest how the training program for recent college graduates could make them better equipped to be of assistance to you?

5. What changes or improvements in organization and planning would you recommend to lessen the engineering staff's work load?

6. Do your working conditions enable you to do your work with peak efficiency? Any recommendations for their improvement?

7. Have you any recommendations to offer to make the indoctrination program for newly-hired college graduates and experienced engineers more effective?

8. How can shop personnel be made more effective in their assistance to you? Have you any shop person(s) you would like to recommend for training as a technician?

9. Do you know of any person(s) within the administrative or manufacturing sections of the company who would make good technical assistants or who would be interested in training for such work? Anyone outside the company? May we have their names?

10. Do you consider your communications with management and your superiors satisfactory? If they could be improved what are your suggestions?

11. Is there any of your routine work which could be performed by mechanical aids or made easier through their use?

12. May we have any other suggestions which you may have for relieving the engineering staff of routine detail so that they may concentrate on purely engineering work?

13. Do you have any suggestions concerning cooperation with local schools and colleges for training student engineers? For use of their facilities? For retaining professors and instructors as consultants and part-time employees?

14. Are there any engineering operations which could be changed in order to reduce waste time and motion?

. . . BASED ON SURVEY OF 495 COMPANIES

second for experienced engineers. Obviously, the experienced engineer will need a shorter, more specialized program. He can take more, faster. Generally he is anxious to get to work.

▶ **The Short Program**—This type is designed to brief the engineer on working procedures and production methods. An example is the three-week, intensive, full-time familiarization course used by a major aircraft manufacturer. It's reported that this course enables engineers to pick up production work quickly. And the newly-employed engineers take less of the supervisors' time for instruction.

▶ **The Long Program**—This is usually a two-year course for junior engineers to provide them with a thorough knowledge of the company's engineering practices.

The National Society of Professional Engineers is now readying for publication a comprehensive and detailed survey on the subject of "How to Improve the Utilization of Engineering Manpower." This article is a condensation of the NSPE survey results which will soon be available from the Society's headquarters at 1121 Fifteenth St., N. W., Washington, D. C. The survey is the second in a series of four reports to engineering management. The first dealt with communications (*CE*, April 1952, p. 272). Subsequent reports will deal with the subjects of attracting qualified engineers and training them in industry.

Typical of the comments from companies which have indoctrination programs or which have recently begun them, is that of a large chemical company. It stated that its orientation program for young engineers had made them more effective during their *first* year of employment as well as from the long-range point of view.

2. How to Make the Existing Engineering Staff More Effective

▶ **Study Your Organization**—Many of the replies to the survey indicate that companies are studying their engineering departments to determine what changes or improvement in organization will make the existing engineering staff more effective.

The survey replies suggest that the companies analyze their engineering departments to effect centralization of top-level engineering. The ground-level work can then be decentralized into district or department areas with

comprehensive standard practices and specifications. Also, it may be possible to consolidate engineering departments through such centralization. This cuts administrative and clerical costs, boosts efficiency and work output.

Clear-cut delegation of authority and responsibility is rated as absolutely necessary. Thus, the engineers know exactly what their responsibilities are and to whom they are accountable.

One company reports that it has increased the effectiveness of its engineering personnel by decreasing the number of engineers per senior engineering supervisor by one-half. Closer supervision brings better results the company says.

▶ **Use Planning Groups**—In order to equate the engineering work load, a large jet engine manufacturer has set up an engineering planning group to take over estimating, scheduling and budget control on engineering projects. This takes the burden from the individual engineers and saves their time for more technical work.

The engineering planning group is set up to take over detail estimating, scheduling and budget control activities for the project engineer. Although this is a central group, individuals within that group are assigned to specific projects and are located physically with the project group.

This is designed to provide the project engineer with the services of an administrative assistant for estimating, scheduling and budget control activities on his project and at the same time maintain common procedures and methods of carrying out these activities by retaining supervision of such personnel through one department.

The project engineer retains authority for his project but gains a thorough knowledge of his schedule and budget situation. This information is readily available and is brought to the engineer's attention usually, together with a recommendation when corrective action seems to be warranted.

Personnel in the planning group are made up of some college graduates in arts, industrial engineering and accounting and non-college graduates with experience in production control or minor administrative assignments. Although there is no set standard with respect to education or experi-

ence, the personnel usually have some related experience.

▶ **Train Engineers for Supervision**—It has been shown that supervisory engineers can obtain better results if they are trained in job methods, supervisory relations and techniques, and conference leadership. By these means, they grow to understand how to get the most from the people working for them, how to organize and find the most efficient methods for getting the work done. Conference leadership training is a management tool of great value in "drawing out" and developing engineers for management.

In line with the recommendations concerning the training of engineers, it is reported advisable that they have some training in human relations. The engineering schools are giving some training in this field. It assumes additional importance in times when the efficient functioning of supporting personnel eases the engineering work load.

3. How to Use Supporting Personnel

The use of supporting personnel to relieve engineers of routine duties is reported as one of the most productive methods of obtaining the fullest utilization of engineering manpower.

One of the survey replies stated that the use of supporting personnel is resultful for "it stimulates them [the engineers] to continue their potentialities and to do the best job with the skills they possess at their present stage. It helps them to develop faster. They seem to lose perspective and morale when kept in jobs which obviously could be done by people with less training."

This comment is indicative of the responses received from many of the companies which participated in the survey. Their careful analysis of the work which engineers are performing often reveals that many of these jobs could be standardized or simplified so that they could be done by supporting personnel. The engineer is then left free for technical engineering work and creative efforts to develop ideas. He can keep associated personnel busy translating his ideas into finished drawings, making test models or testing his theories. The success with which this can be done depends upon the nature of the engineering work, the creative ability of the engineer and how well he can direct the work of sub-professional personnel.

YOU AND YOUR JOB, *cont. . .*

▶ **Use Technical Aides**—At one of the large communications laboratories, the ratio of technical aides to engineers is steadily increasing as this supporting group is assigned more and more of the detail work. These aides are trained for careers in their fields. This program is distinct from the engineering training program. Some of the men and women trained as technical aides attend engineering colleges to further their education and eventually become professional engineers.

These technical aides are recruited from technical institutes where they take courses of 18 months to 2 years in length. The training gives them the skills and fundamental theory to carry out the instructions of the engineers. Other sources of technical talent are people specially trained by the armed forces or other industries.

Because of the complex and specialized nature of communications research and development, these people are usually given on-the-job training with individual engineers.

Several educators have suggested that more effective use be made of the engineering students who do not complete their course of study. NSPE suggests engineering colleges keep careful records of their men and women who "wash out" while in college. They should suggest that these men enter sub-professional engineering work.

It is estimated that about 50 percent of the students do not complete their studies. Obviously, they have some technical ability or they would not have been accepted for training by the engineering colleges. They have also had the advantage of some technical training and should be encouraged to continue their training on a less complex level than that of engineering. In this way, they would serve a very vital function in industry while doing work for which they are suited.

▶ **These Are Some Duties That Can Be Delegated to Subordinates**—Survey replies indicated that subordinate personnel are performing the following duties:

Drafting, designing, incorporating changes on drawings, collecting and collating data, calculating, computations, ordinary layout, expediting, cost accounting, keeping records, market research, quantity surveys, filing, requisitioning, checking orders for material, printing, preparation of charts

and graphs, expanding standard books, library administration.

Handling details with shops, investigating customer complaints, preventive maintenance, operation of experimental equipment and pilot plants, preparation of parts of surveys and studies, transmittal of information, leg work.

The nature of the work which supporting personnel can do varies according to the industry. However, the above list shows that there are many tasks which were formerly thought "engineers work" which can be done by supporting personnel.

4. How to Avoid Wasting Engineering Talent

Industry has been accused, at times, of hoarding engineering talent and using engineers for many relatively unimportant technical assignments. The survey indicates that this is not the general practice. Survey replies indicate that 85 percent of the engineers spend at least three-quarters of their time in technical engineering work.

While engineers are used for other than strictly engineering work, it is usually in some executive position. In reply to the question, "Do you employ graduate engineers in other than strictly engineering work?" 69 percent of the companies stated they did. Their replies indicated that more than half of them employed engineers in executive positions outside the engineering department or in sales. A quarter of them employed engineers in customer relations while almost 20 percent of them used engineers in industrial relations work. In many cases, the engineers' assignments included more than one of these job categories.

▶ **What Conclusions Can Be Drawn?**—Obviously, it would not be practical to shift an engineer who holds a highly administrative job. However, there are positions where engineers could be shifted to technical work with satisfaction for all concerned.

Also, subordinate personnel can relieve the engineering executive of many of the administrative tasks thus freeing him for more engineering work.

5. How to Find Auxiliary Sources of Engineering Talent

▶ **What Other Sources Are Now Being Used?**—As the engineering workload has become heavier within their own

organizations, at least 50 percent of the responding companies are using some auxiliary sources of engineering talent to ease the strain on their engineering staffs.

Replies showed this breakdown:

- Engineering consulting firms ..... 55 percent
- Drafting consulting firms ..... 31 percent
- Retired engineers ..... 20 percent
- Non-citizen engineers ..9.8 percent
- Research organizations ..26 percent

While about half of the companies surveyed used outside consultants to good advantage, others commented that they did not use them for such reasons as: "they are not practical in our field"; "they take too much of our own engineers' time"; "our work is too specialized"; "confidential information could reach competitors."

Retired engineers were used by about twenty percent of the companies. In some cases, they stated that they are deferring retirements in order to keep their engineers with them. A less strenuous work schedule was designed for these.

In other cases, former employees are recalled from the retired list to supplement the engineering staff. A general comment is that the use of retired engineers depended greatly upon the individual's physical and mental condition as well as his ability.

Non-citizen engineers are used less than half as much as are retired engineers. Emphasis here is on the fact they are acceptable only if they have their first papers or have indicated their intention to become citizens.

► **College Engineering Students Make Good Engineering Assistants**—The cooperative engineering student plan has met with great success and is well received in companies participating.

Use of such cooperative students depends upon the relations between the companies and the engineering colleges as well as on their proximity to them. Therefore, the program may not be available to all companies although some work with schools as far as five hundred miles away. It is an idea worth looking into, in any case.

An alternate use of engineering college students is summer vacation assignments. They can serve as engineering assistants, thus relieving the engineers of some routine tasks while supplementing their training with practical work. College students were employed by 66 percent of the com-

panies surveyed. However, and somewhat surprisingly, only a small percentage of summer employees join the companies following their graduation. This indicates the need for a company selling job.

▶ **Women in Engineering**–About women in engineering, there is a great deal of feeling–both pro and con. The concensus is that women engineers are well received where they are now employed. The majority of companies replied that they would hire them if they were available.

Survey replies showed that some companies have relaxed hiring standards and are using part-time personnel to meet their engineering needs. However, others stated firmly that they had not relaxed their hiring standards and did not intend to do so in the forseeable future.

6. How to Cut Down Your Turnover Rate

▶ **Company Sponsored Benefits and Incentives Help Reduce Turnover**–The dictionary defines benefits as "whatever promotes welfare." Incentives are defined as "motives, whatever incites to action."

Benefits include hospitalization, insurance and pension plans which contribute to the employee's welfare.

Incentives are usually financial such as more pay, the offer of base pay plus profit sharing, and the opportunity for rapid advancement.

Although 81 percent of the companies felt that company-sponsored benefits are effective in reducing engineering turnover, many of them pointed out that their relative importance has declined, particularly among the larger companies, since most of them now have hospitalization, insurance and pension plans.

Generally, it was indicated that the various incentives which the companies offered were more important than the benefits to engineers. The basic reason given for this was that the incentives offered by an individual company enabled it to afford the engineers advantages which could not be secured in most other companies.

The relative importance of the incentives was given as follows:

1. Opportunity for advancement
2. Stability of employment
3. Chance to receive extra training
4. Essential industry
5. Profit sharing plan

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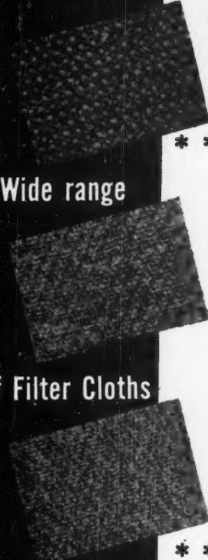

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The survey indicated also that Salary Stabilization Board regulations had proved costly in terms of lowered morale and loss of key personnel. A number of companies responded that these regulations had an adverse effect upon their wage situations.

▶ **Effect of Military**—One of the major demands on the limited engineering manpower is the increase in the requirements of the armed forces. Much study and time has been devoted to working out an equitable solution but the situation remains unclear.

The difficulty of obtaining deferments for their engineering personnel has kept many companies from seeking them. Only 38 percent of the survey participants requested deferments for their young engineers eligible under Selective Service. A somewhat higher number, 43 percent, asked that their engineers in the Reserve be granted deferment. The replies showed that the deferment is granted less often in the Reserve group which generally constitutes the more highly-trained engineers. When engineers are deferred, it is usually for six months only. A number of the firms find that their engineers feel it is hardly worth the trouble and do not request deferment.

7. How to Attract People to Engineering Careers

The need for interesting students and vocational guidance counselors in engineering as a career is well understood by most companies, according to the survey results. Copies of carefully prepared booklets and folders are distributed to the schools and colleges by the larger companies. These present the opportunities in engineering as they apply to these companies and give an indication of the impressive part which engineering plays in their activities.

In smaller firms, the approach to the schools is on a more personal basis and usually involves talks by company executives to student groups. These firms often participate in "Career Days," at which representatives of local industries brief the students on the opportunities open to them.

Efforts to interest and stimulate students to consider science as a career are sponsored by several of the larger companies in the form of traveling exhibits. Examples are the General Motors show, "Previews of Progress," the Westinghouse, "Energy in Ac-

tion," and General Electric's "House of Magic." Although such shows play to civic clubs and other like groups as well as to high schools, they serve to encourage interest in science among parents and students, which, in turn, increases the number of students who consider engineering careers.

In addition to these efforts to urge students to consider engineering as a career, a number of companies participate in student guidance clinics and summer training programs. The importance of engineering in industry's operations is demonstrated in practical form by displays of working models of plants and equipment as well as guided trips through factories, laboratories and other industrial facilities. Industry can also help with scholarships for worthy students.

► **What Role Can Education Play?**—Many educators fear that industry's demand for engineers may encourage the over-extension of engineering college facilities. This could cause a decline in their education standards. They want industry to supply them with the financial backing necessary to increase their student capacity and improve their teaching facilities.

At present, most private engineering colleges use a quota system limiting the number of students in each engineering field. This seeks to avoid overtaxing the capacity of their teaching staff, their space and their laboratory facilities. By so doing, they feel that they can avoid lowering standards.

► **Aid To Teachers By Industry**—Survey results show that a number of companies are aiding engineering students and colleges. The colleges, in turn, are working with the industries in their areas to provide them with cooperative engineering students and research facilities.

Industry can help to insure the high standards of engineering instruction by providing part-time jobs and counseling work for college engineering professors and instructors. It is particularly important that these men have some additional source of income if they are to continue in the teaching profession. It is equally important that adequate science teachers be available in high schools where interest in science is initiated.

8. How To Evaluate Your Present Engineering Staff

Periodic appraisal plus personal observation appears to be the most popular method of evaluating the work of

the engineering staffs. There are differences of opinion among survey participants about the most effective periods for appraisal. In most common use are the semi-annual, annual and quarterly. Semi-annual work appraisals are most frequently used by the companies surveyed.

There are, of course, many refinements of the evaluation techniques used. One large manufacturer uses the following comprehensive rule:

"All prospects are rated on nine factors: loyalty, experience, training, knowledge, disposition; ability to cooperate, to supervise and to delegate, and the opinion of associates."

Psychology tests are being used by many of the larger companies which retain industrial psychologists or psychiatrists. One large aircraft manufacturer uses a program of psychological ability, interest and personality tests. An oil refining company combines another factor with industrial psychology; it evaluates its engineers by: "a careful observation of performance during short-term promotions to sub-supervisory assignments; use of industrial psychologists for testing and evaluating the potential of all likely material for supervisory assignments within the engineering department."

▶ **How High Is the Potential of the Engineering Staff Rated?**—Although the majority of survey answers indicated that the potential for advancement of the present engineering staff was either excellent or good, there were some replies which indicated that the potential was fair, satisfactory, limited or not good. In one case, it was rated poor. Although these less favorable replies were in the minority, there were enough of them to indicate that industry is not entirely satisfied with work of its engineering staffs or their potential. The spokesman for a large steel manufacturer commented concerning engineering turnover: "No problem; just a shortage of good, trained engineers (plenty of poor ones)."

This suggests that engineering staffs would do well to review their work and their potential for advancement to determine whether or not they are meeting their companies' needs and their own professional standards. By this analysis, they can check on their performance and methods whereby they can increase their potential for greater responsibility.

Petroleum refining and chemical manufacturing are industries of almost incredible superlatives. They have spent for new facilities since 1945 a sum roughly equal to total gross plant investment for all prior years. In these accomplishments, The Lummus Company—as design engineers and constructors—was privileged to play a major role.

But the years ahead are apt to make the past look puny by comparison. This year, for example, oil companies will top 1951 capital spending by over a third—chemical companies by nearly a fifth. Preliminary plans through 1955 show little or no relaxation from this rate.

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2. Maleic Anhydride
3. Santomerse 80
4. Santomerse No. 1 in Fertilizers

Additional information on any of these subjects will be provided by any Monsanto Sales Office in response to your request by coupon or letter.

Polyester Resins Becoming Leaders In Plastic Industry

1 A comer in the chemical business—the polyester resin group—is already living up to its advance billing.

Field reports from various parts of the country show that polyester resins are making their mark in the fabrication of a wide variety of products. Using this group of compounds, manufacturers can mold 37-foot sailing hulls in one operation . . . produce strong, light-weight automobile bodies . . . turn out countless other products such as luggage, pipe, outdoor signs and many more items.

These low-pressure laminating and contour molding resins are produced by copolymerizing Monsanto's styrene monomer in varied proportions with unsaturated polyester resins. They have tremendous potential when used to laminate fiber, glass cloth, paper and other materials. They also are excellent for contour-molding both large and small lay-ups, with little pressure and low heat.

Market doubles in three years

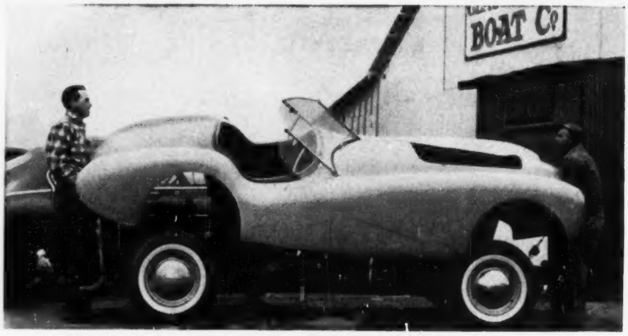
The field of application for these laminates and moldings is so promising that conservative estimates show the market doubling every three years.

Monsanto has assumed a position as a leading supplier of raw materials used in polyester resins.

From this *one* company you can obtain the maleic or phthalic anhydride which reacts with a polyalcohol. Styrene monomer for copolymerization is available from Monsanto's new plant at Texas City.

Because it furnishes these three products Monsanto is being selected by a wide number of manufacturers as headquarters for raw materials used in polyester resins.

For more information, send in the coupon on the opposite page.



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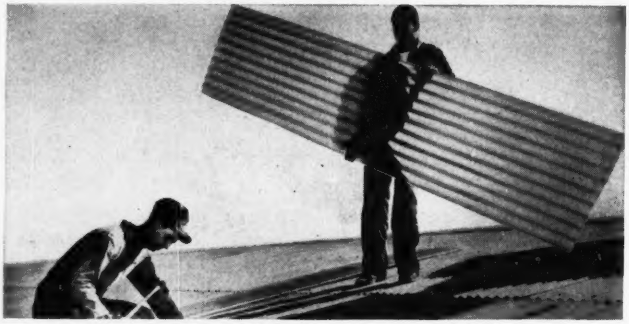
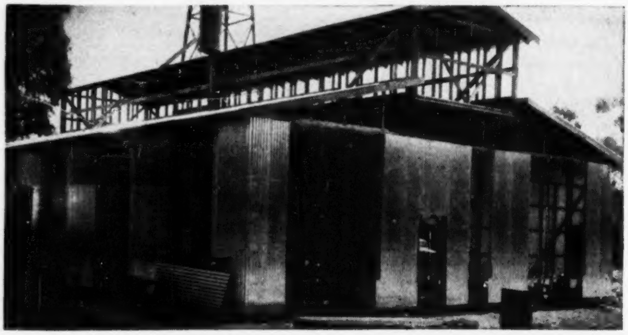


ROOFING for industrial buildings can now be made from polyester resins made with Monsanto's styrene monomer.



INDUSTRIAL BUILDINGS use polyester resin panels for exterior covering because they are weather-resistant, translucent and inexpensive.

Maleic Anhydride Briquettes Available

2 Chemical processors are now using maleic anhydride in briquette form (a Monsanto exclusive) to increase operating efficiency.

Processors report that these briquettes offer several advantages. Their compact size—about one and three-quarter inches in length, plus a highly uniform shape, makes the briquettes ideal for fast weighing and handling.

The briquette shape is growing in user popularity for another reason, too—dusting is minimized with this form of maleic anhydride. In addition, the convenient 80-pound bag the briquettes are packed in can be easily palletized. This simplifies material-handling problems inside the plant.

Caking is also virtually eliminated with this form of maleic, and moisture pickup minimized.

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Fertilizer in bag on right has Santomerse No. 1 (spray-dried) added. Bag on left does not include Santomerse. Note difference in caking.

James E. Seymour, Chief Chemist, Illinois Farm Supply Company, adding Santomerse No. 1 (spray-dried) to a test batch of fertilizer.

Wetting Agent Aids New-Type Fertilizer

4 The development of a new-type fertilizer was announced at a recent meeting of the American Farm Research Association by Mr. James E. Seymour, Chief Chemist for the Illinois Farm Supply Company.

According to Mr. Seymour, the new plant food, called "Gro-Flo," flows easily through grain drills, fertilizer attachments and other types of applicators because of its uniform particle size. It also exhibits unusually good stability in storage.

During his talk, Mr. Seymour described the experiments which led to the discovery that a faster and more complete reaction of mixed fertilizer ingredients would result through the use of minute amounts of surface-active agents. The result, he said, is much shorter curing time and a non-hardening, free-flowing product of uniformly high analysis.

The surface-active agent used by the Illinois Farm Supply, Mr. Seymour said, is Santomerse No. 1, an all-purpose wetting agent manufactured by Monsanto Chemical Company.

The specific grade of Santomerse No. 1 used is light in density and spray-dried. This all-purpose wetting agent is of the anionic type and is widely used as an emulsifier, dispersant and wetting agent in the textile, dairy and industrial cleaning fields.

Manufacturers of fertilizers find the use of Santomerse has several advantages. It cuts costly aging time and permits a faster rate of bagging of finished product. It reduces the tendency of mixed goods to set up and harden in bags during long periods of storage. Moreover, the finished product retains an improved texture, free of hard lumps which formerly caused clogging of applicators. For complete details on this new application for wetting agents, send in the attached coupon.

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Names in the News Edited by Frances Arne

MAN OF THE MONTH: William T. Nichols

Director of Monsanto's general engineering department, he's about to take on the presidency of AIChE.

Bill Nichols came skimming out of his borrowed office at Monsanto's Park Ave. location. He hardly had me inside before he started talking about his current baby—the company's new central headquarters to be built in the St. Louis suburbs. He wanted me to know how much planning had gone into the job. They had to think about space for the engineering and service departments, quick communications for the executives, a location convenient for the densest population of key employees. . . He pulled out a sheaf of blueprints, maps and architects' drawings which showed how each of the diverse problems had been solved.

"The general engineering department will help on any kind of engineering projects the company has to take on," he said because I had been surprised at finding a chemical engineer so wrapped up in architectural matters. "As head of the department I supervise all kinds of engineers—mechanical, electrical, civil. . ."

He compares himself to a utility infielder and credits what success he's had to the resemblance. During his career he's had jobs in research, engineering, sales and production and made a go of them all. This non-specialization, he says, has given him a clear view of his whole field and how its segments fit together. He feels at home with any kind of problem, knows where to grab hold of it.

He complains that in the present age of specialization and big complex companies, young men cannot develop this kind of versatility. He got the biggest chunk of his training at Westvaco. He was with them from 1930 to 1949, years in which the company underwent a tremendous expansion. Called upon to try his hand at many different phases of the business, he grew and broadened with the company.

Although he insists that his whole career in chemical engineering has been colored with excitement, he is most talkative about two projects which he headed for Westvaco: (1) the first commercial elemental phosphorus plant based on Idaho phosphates; (2) the first commercial soda ash operation based on Wyoming trona mines. They involved Nichols in: deciding on suitable sites and processing methods; negotiating for the rights to use them; convincing local Chambers of Commerce and townspeople that chemical operations would not destroy their countryside.

The travelling required by these projects was nothing unusual for Nichols. However his early life was firmly rooted in Pittsburgh where he was born, attended the University of Pittsburgh and worked for Mellon Institute. But in 1926 he moved to Auburn, N. Y., as a research engineer for the Columbian Rope Co. His headquarters while with Westvaco was shifted from Carteret, N. J., to South Charleston, W. Va., to New York. Then when he joined Monsanto in 1949 he moved to St. Louis.

"If you're going to stay in the chemical industry, you have to be relaxed about jumping around the country." But, he likes living in the Midwest best because he finds its people "a little more relaxed and friendly than most." Nichols himself seems pretty relaxed, if you can picture a relaxed dynamo.

Robert M. Cornforth. Vice president in charge of sales, W. M. Barnes Co., Los Angeles engineers and constructors to the petroleum and chemical industries. Formerly, manager of sales of Houdry Process Corp., Philadelphia. Entered the petroleum industry in 1937 as a chemical engineer with Standard Oil Co. of Indiana. Studied at the University of Tennessee, MIT and Northwestern.

William S. Munro. Manager of the Seattle plant of Monsanto Chemical Co.'s western division. Since 1947 chief chemical engineer.

Lewis H. Rogers. Head of the division of analytical chemistry, National Dairy Research Laboratories, Inc., Oakdale, N. Y. Has been in charge of an analytical research group in a division of Union Carbide and Carbon Corp. operating at Oak Ridge under the auspices of AEC. Doctorate from Cornell.

J. H. Lindemuth. Works manager at Kaiser Aluminum & Chemical Corp., Chalmette, La. plant. His successor as plant manager at the Spokane works: **Walter Bast,** former assistant manager at Mead.

Sei Sujishi. From instructor of chemistry to assistant professor, Illinois

Institute of Technology. With the faculty since 1949. Doctorate in chemistry from Purdue.

O. B. J. Fraser. Recipient of the Samuel Wylie Miller Memorial Medal presented by the American Welding Society for meritorious achievements in the art of welding. Assistant manager of the development and research division, International Nickel Co., New York. With the company since 1917. Graduate of Queen's University, Kingston, Canada.

O. B. J. Fraser

Edward A. Murray

Edward A. Murray. Founder of a new consulting service in the fields of textile sizing and finishing. He has offices at Anderson and Clemson, S. C. He has been a member of the Deering Milliken Research Trust in charge of its chemical section.

George O. Rudkin, Jr. Manager, chemical division, R. K. Laros Co., Bethlehem, Pa. Formerly with Chas. Pfizer's research and development division.

Thomas E. Stockdale. Manager of Standard Oil of Indiana's refinery to be built at Mandan, N. D. His successor as general superintendent of Standard's Wood River, Ill., refinery: **Ford H. Blunck,** formerly manager of the projects, capital expenditures and miscellaneous contracts division in the company's general office manufacturing department at Chicago.

Norman L. Meyerson. Assistant manager, research and development department, Worthington Corp. With the company since 1942. Chemical engineering graduate of the University of Missouri.

W. J. O'Connell. Executive vice president, Trendex Co., Memphis manu-

facturers of fatty acids. Previously in charge of the fatty acids division, Vegetable Oil Products Co., Wilmington, Calif. Before that, vice president and director in charge of western operations for W. C. Hardesty & Co.

R. W. Millar. Head of the chemical engineering department at Shell Development Co., Emeryville, Calif. His successor as head of the physical chemistry department: **C. L. Dunn.** Mr. Dunn's successor as assistant department head: **R. L. Maycock.**

V. C. Irvine. Western division sales manager for Shell Chemical Corp. with offices in San Francisco. Formerly manager of the product development department in New York.

Elihu D. Grossman. New instructor in chemical engineering, Drexel Institute of Technology. New instructor in chemistry: **Ann D. White.**

Harry A. Carlberg. Manager of plant engineering in GE's manufacturing department at Hanford Works, Richland, Wash. At Hanford since 1943, first with the Corps of Engineers, next with Du Pont and then with GE. Graduate of the University of Wisconsin.

Stephen T. Orr. Member of the president's staff with the rank of vice president, Wyandotte Chemicals Corp., Wyandotte, Mich. His successor as general manager of manufacturing, Michigan Alkali Division: **Frank Wolcott** who has been Mr. Orr's immediate assistant.

Mervin E. Runner. From instructor to assistant professor, chemistry department, Illinois Institute of Technology. From 1943 to 1950, assistant instructor in general inorganic chemistry, University of Pennsylvania. Doctorate from Penn.

Richard B. Bernstein. From assistant professor to associate professor, Illinois Institute of Technology. Joined the faculty in 1948; named head of the instrumentation lab, 1951. Doctorate from Columbia.

Jerome Wilkenfeld. Supervisor of process study, Hooker Electrochemical Co., Niagara Falls, N. Y. Has

been with the process study group since 1945. Chemical engineering graduate of City College of New York. New head of research technical literature: **Alexander D. Kischitz,** formerly a research chemist with the company.

Robert J. Sarraf. Chief chemical engineer, Rockwell Mfg. Co.'s meter and valve division. With the company since 1947 as a chemical engineer at its Pittsburgh headquarters. Previously with Mellon Institute serving as a chemical engineer on research and development projects. Studied at the University of Pittsburgh.


R. J. Sarraf


Collins Ketcham

Collins M. Ketcham. Staff assistant in the general engineering department, Glidden Co., Cleveland. Has been an engineering assistant for the past year at the company's Elmhurst, L. I., plant. Other positions: special studies engineer for Du Pont from 1940 to 1943; assistant general superintendent of the vegetable oil refinery and margarine operations of Wilson and Co.; general superintendent of a large vegetable oil refinery in Sao Paulo, Brazil from 1948 until last year.

Gordon M. Williams. Assistant supervisor in the agricultural chemicals research section, Pittsburgh Coke & Chemical Co.'s research and development department. Has been assistant to the technical director, Holland Coke and Chemical Co., Holland, Mich. Before that, with the Imperial Paper and Color Corp. in its organic research division. Studied at Iowa State College and the University of Chicago.

Nicholas V. Poletika. Assistant director of research, lumber and wood products laboratory, Timber Engineering Co. Has served as manager of the laboratory since 1949.

His successor: **Robert R. Blumenstein.** Mr. Blumenstein's successor as assistant laboratory manager: **Charles H. Hoffman.**

Miles D. Catton. Assistant to the vice president for research and development, Portland Cement Assn. Since 1949, director of development. His successor: **Douglas McHenry,** previously administrative assistant to the vice president for research and development.

J. J. Barker. Head of the process department, Walter Kidde Nuclear Laboratories. Formerly chemical engineer for Kellex Corp. engaged in the design of process equipment for the K-25 gaseous diffusion plant at Oak Ridge. New chemical engineers on the process department staff. **K. E. Diehl, D. Mars, E. S. Roszkowski, J. F. Sheehan.**

Oscar P. Cohen. Group leader in the research and development department, Monsanto's Merrimac Division, Everett, Mass. Joined the company in 1946 as a research chemist. Doctorate from Clark University.

Francis J. Curtis. Transferred to Monsanto's headquarters in St. Louis to handle special assignments for the company president. A Monsanto vice president, Mr. Curtis has been director of the company's industrial preparedness at Washington, D. C. With the company since 1915, Mr. Curtis was elected president of the Society of Chemical Industry earlier this year. His successor in Washington: **Edward W. Gamble Jr.,** who has been in charge of the company's Washington office since 1951.

Roland E. Kremers. Research associate in organic chemistry, Institute of Paper Chemistry, Appleton, Wis. Formerly with the central laboratories division of General Foods.

Frank Christenson. President and chairman of the board of the Industrial Mineral Fiber Institute. Executive vice president, Refractory & Insulation Corp.

W. E. Kleincke. Superintendent of the Shadyside Research Laboratory of Barrett Division, Allied Chemical & Dye Corp. With Barrett for five

years. Previously director of research for the Johnson-March Corp., Long Island City, N. Y.

E. V. Murphree. Recipient of the Industrial Research Institute Medal for 1953. President of Standard Oil Development Co. since 1947. President of the permanent council of the World Petroleum Congress. Studied at the University of Kentucky and MIT.

E. V. Murphree

W. Wayne Albright

W. Wayne Albright. President of the National Lubricating Grease Institute. Assistant manager, lubricating and sales technical service department, Standard Oil Co. Indiana) since 1948. Joined the company in 1922. Chemical engineering graduate of the University of Michigan.

R. C. Leonard. Product manager, caustic soda and chlorine, Michigan Alkali Division, Wyandotte Chemicals Corp. Other divisional appointments: **P. M. Bigley** to product manager, soda ash, dry ice and bicarbonate of soda; **R. K. Rigger** to product manager, synthetic detergents; **T. R. Boyle** to administrative assistant to the vice president.

Wayne H. Keller. Director of the chemistry department, National Research Corp., Cambridge, Mass. Since 1945, assistant technical director on the uranium project, Mallinckrodt Chemical Works, St. Louis, Mo. From 1942 to 1945, director of chemical metallurgy for the Manhattan District program at Iowa State College. Doctorate in physical chemistry from Cornell.

Merritt L. Kastens. Assistant to the director of Stanford Research Institute. With *Chemical and Engineering News* and *Industrial & Engineering Chemistry* since 1946 in San Francisco, Chicago and New

York. He was associate editor at the time of his resignation.

Anthony P. Massa. Research fellow at the Polytechnic Institute of Brooklyn. Sponsored by the AIChE. On leave as a process engineer from the H. K. Ferguson Co.

John McGavack. Technical director of the plantation division of United States Rubber Co. With the company since 1920 and since 1936 has headed the crude rubber and latex department at the general laboratories.

Robert N. Pennie. Research director, Amalgamated Chemical Corp., Philadelphia.

David T. Mowry. Transferred from the central research department to the development department, phosphate division, Monsanto Chemical Co. Came to Monsanto in 1941 as a research chemist; appointed group leader in 1945. Key worker in the development of Krilium soil conditioner. Doctorate in chemistry from Ohio State.

Bruno R. Roberts. Research scientist with the research and development department, Chemstrand Corp. Formerly engaged in fiber research at the company's Dayton laboratories. Had been a research scientist for Monsanto for nine years before coming to Chemstrand. Prior to that he maintained his own research laboratory firm in New York. Doctorate in chemical engineering from Vienna Institute of Technology.

S. Barksdale Penick Jr. Elected honorary past president, American Pharmaceutical Manufactur' Assn. President of S. B. Penick & Co., New York.

Arthur H. Boultbee, manager of manufacturing research, Shell Oil Co. Joined the company as a chemist at its Martinez refinery in 1935. Doctorate in chemical engineering from the University of Toronto.

James W. Perry. Director of Bjorksten Labs' new center for literature research in Washington, D. C.

Callaway Brown. Senior chemist in the chemistry and chemical engineering department, Armour Re-

search Foundation. With the foundation since 1950.

S. A. Ballard. Head of the petroleum refining department at Shell Development Co.'s Emeryville Laboratories in California. Came to Emeryville in 1937. Served as department head, organic synthesis department, until last year when he was sent on a special assignment with the Shell group at the Amsterdam Laboratory and The Hague office.

Arthur L. Gordon. Research chemist, A. E. Staley Mfg. Co., Decatur, Ill. Doctorate from the University of Minnesota. New analytical chemist: **Ellis Lehman.** Formerly with the Lincoln Laboratories, Decatur. Chemistry graduate of Manchester College, Manchester, Ind.

Jack Hensel. Supervisor of analytical research, Pittsburgh Coke & Chemical Co.'s research and development department. New assistant supervisors of agricultural chemical research: **William R. Davie** and **Arthur M. Gladstone.**

Philip A. Singelton. Managing director of Monsanto Chemicals Ltd., British subsidiary of Monsanto Chemical Co. Has been acting managing director. Joined the British company in 1950 and has been a director since 1951. With the American company since 1940 when he became a member of its Merrimac division. New assistant to the chairman of the British company: **W. D. Scott,** a member of the board of directors since 1948. Joined the company in 1936 as a research chemist and in 1942 was appointed chief chemist in charge of research, development and patent activities.

A. E. Moore. Vice president and director of research and development, R. M. Hollingshead Corp., Camden, N. J. Joined the company in 1923 as laboratory assistant to the chief chemist. Subsequent positions: assistant chief chemist, factory production manager, assistant plant manager, chief chemist and, most recently, director of the new products development division. Graduate of Drexel Institute of Technology. New director of government and industrial research:

JEFFERSON CHEMICALS

"ESSENTIAL CHEMICALS FROM HYDROCARBON SOURCES"

Ethylene Oxide — For use as a starting material for the manufacture of acrylonitrile and nonionic surface active agents; a sterilizing agent and fumigant; and, in general, a very reactive chemical intermediate.

Ethylene Glycol — For use as a permanent-type antifreeze; a heat transfer medium; a raw material in the manufacture of low-freezing dynamite; a starting material for the production of synthetic fibers and alkyd resins; a plasticizer; a constituent of hydraulic fluids; and a general solvent and chemical intermediate.

Ethylene Dichloride — For use as an ingredient of tetraethyl lead fluid; a solvent for fats, oils, and waxes; a metal degreaser; a spotting agent for textile cleaning; a chemical intermediate for use in resin manufacture and in other processes.

Diethylene Glycol — For use as a dehydrating agent for natural gas; a moistening agent for tobacco, glue, and gelatin; a textile lubricant and coupling agent; a solvent in textile dyeing and printing; a constituent of hydraulic fluids; a chemical intermediate.

Monoethanolamine — For use as a gas scrubbing agent for recovery of hydrogen sulfide and carbon dioxide, and as a chemical intermediate in the manufacture of various surface active agents, rubber chemicals, and other materials, and as an agent in the manufacture of antibiotics.

Diethanolamine — For use as an intermediate in the manufacture of surface active agents used in textile specialties, herbicides, petroleum demulsifiers, etc.; as a gas scrubber in refinery operations; a rubber chemicals intermediate.

Triethanolamine — For use as an intermediate in manufacture of surface active agents used in textile specialties, waxes and polishes, herbicides, petroleum demulsifiers, toilet goods, cement additives, cutting oils, etc.; a rubber chemicals intermediate.

Nonyl Phenol* — For use as an anionic and nonionic surface active agent intermediate; a starting material for the manufacture of lubricating oil additives, stabilizers, petroleum demulsifiers, oil-soluble phenolic resins and plasticizers.

**A new Jefferson chemical now being brought into full production.*

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Names in the News, *cont...*

V. M. Mantz who has been director of research since 1947. His successor: **V. Esposito** who has been assistant director.

Edward A. Hutton. Chemical engineer, process study group, Hooker Electrochemical Co., Niagara Falls, N. Y. Graduate of Clarkson College of Technology. New chemist in the works laboratory: **Robert H. Pugh.** Previous employers: National Carbon Co., Du Pont, U. S. Rubber Reserve, Harshaw Chemical Co. Graduate of Ohio Northern University.

Francis O. Case. President of the newly-formed Anaconda Aluminum Co. Has been vice president of Anaconda Copper Mining Co. since 1948.

Savery F. Coneybear. Vice chairman of the American Institute of Chemists, New York chapter. Vice president of Evans Research and Development Corp. New secretary-treasurer of the chapter: **Richard L. Moore,** assistant treasurer of Foster D. Snell, Inc.

Herbert A. Stratford. Executive vice president, Morton Salt Co. Director of the company since 1945, vice president in charge of sales since 1942.

Henry A. Hill. Assistant manager, National Polychemicals, Inc., Boston, Mass. Has been with Dewey and Almy Chemical Co. Before that, director of research for the Atlantic Research Associates and vice president of the National Atlantic Research Corp.

Norry W. Hastings. Chief Chemist for Rezolin, Inc., Los Angeles. Previous employers: Make-A-Lot Plastic Corp., Boston; Novell Resin Co., Azusa, Calif.; North American Aviation Corp. Chemistry graduate of Northeastern University, Boston.

Arthur Walters. General manager of the GE Taunton, Mass., plant. Formerly supervisor of process engineering at Taunton. His successor: **John E. Faloon,** formerly an application engineer for the company. New plant engineer of the company's Waterford silicone products plant:

Joseph C. Mogavero who has been facilities engineer of the chemical department manufacturing division.

Lloyd I. Volckening. Chairman of the Drug, Allied Chemical & Allied Trades Section of the New York Board of Trade. President, the Ivers-Lee Co.

Edward Mallinckrodt. Recipient of the annual award to an outstanding chemist of the St. Louis section of ACS. Chairman of the board, Mallinckrodt Chemical Works.

C. H. Atkins. Chief sanitary engineer of the Public Health Mission to India under the Point IV program. Has been chief of the division of sanitation, Public Health Service, Federal Security Agency. His successor: **Leonard M. Board** who has been assistant chief since 1948.

Louis M. Sherman. Associate director of product development in charge of industrial chemicals, Ethyl Corp., New York. For the past six years, associated with American Cyanamid and its subsidiary, Chemical Construction Co. Chemical engineering graduate of MIT.

R. L. Hockley. From executive vice president to president, Davison Chemical Corp., Baltimore. With the company since 1934. Previous employers: Campbell Metal Window Co., Worthington Pump and Machinery Co., G. D. Penniman. Cornell graduate.

George W. Moyers. Member of the board, International Mineral & Chemical Corp. Continues as vice president in charge of the phosphate division, International Minerals & Chemical Corp., New York. With the company for 25 years.

John F. Hooper. Chief chemist, Jesup Division, Rayonier Inc. Has been with the Rayonier research laboratories at Shelton, Wash., for the past 12 years. Studied at the University of Maine and Washington State College.

J. H. Frankfort. Chief project engineer, Walter Kidde Nuclear Laboratories. Formerly with the H. K. Ferguson Co. where he recently served as chief project engineer at the National Lead Co.'s $14 million

titanium plant at Henderson, Nev. Before that, with Du Pont for seven years in which he undertook atomic assignments at Oak Ridge and Hanford.

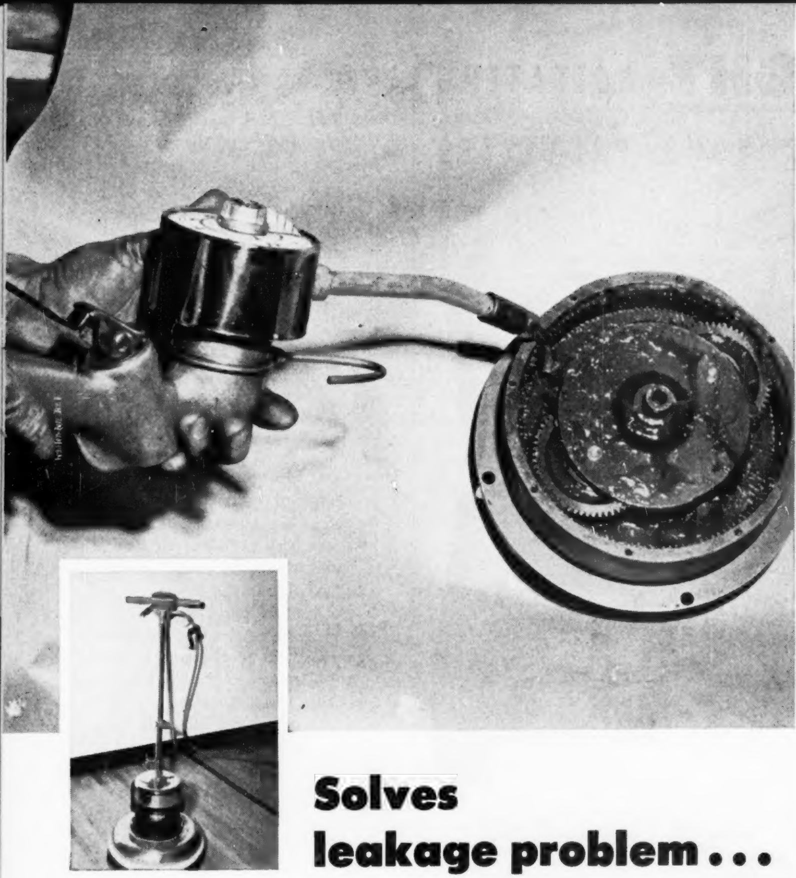
Raymond F. Moran. Resident manager of the Newark, Calif., plant of Westvaco Chemical Division, Food Machinery and Chemical Corp. With Westvaco for 15 years in various positions in the South Charlestown and Newark plants as well as the division's central office in New York. New general superintendent at the Newark plant: **S. M. Cimino** who has been with Westvaco for 13 years.

William R. Hainsworth. Technical advisor to the executive vice president, Fluor Corp., Ltd. Formerly research director and vice president in charge of engineering for Servel, Inc.

Ted L. Lenzen. A vice president of Standard Oil Co. of California. Has been manager of the company's eastern hemisphere operations and has been closely affiliated with the Middle East oil developments since 1938.

Joseph Schulein. Advisory board of the ACS's news service and only West Coast representative. Associate professor of chemical engineering at Oregon State College.

George B. Hughey. Area technical superintendent of intermediate operations, Chemstrand Corp's nylon manufacturing and process plant under construction at Pensacola, Fla. Has been director of pulp and paper research, West Virginia Pulp and Paper Co., Covington, Va., and chemical engineering supervisor with Merck and Co., Rahway, N. J. Doctorate from Ohio State. New textile area superintendent: **Kenneth Johnson.** Previously employed by Commercial Solvents Corp. Doctorate from Purdue. New area technical superintendent of yarn operations: **Paul D. Emerson.** Has been a research engineer with American Viscose Corp., Scott Paper Co., Du Pont. New area superintendent of the adipic acid plant: **George Kazan, Jr.** Has been development supervisor for the General Chemical Division at North Elay-



Solves leakage problem . . .

● Multi-clean Products, Inc., St. Paul, Minnesota, manufactures industrial floor polishing and scrubbing machines. The machines are shipped with grease already installed in gear reduction units. The problem faced by this company was one of finding a grease that would stand up under hard service and not leak from the gear units. Greases tried either caused or threatened leakage troubles.

Called in on this problem, a Standard Oil lubrication specialist recommended STANOBAR Grease "S", a highly stable grease with a unique adhesive characteristic. Given an accelerated service test, STANOBAR did not leak from the gear unit, and its consistency showed no change that would later cause a leakage problem. There was no wear of gears or bearings. Adopted for use in the units, STANOBAR has solved this company's lubrication problem on every count. Officials have been able to eliminate the costly and troublesome practice of having all units returned to the factory, at 12 months intervals, to be repacked with grease.

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Grease

The same lubricating qualities of STANOBAR that solved this problem for Multi-clean Products, Inc. can serve you in a wide variety of applications. A Standard Oil lubrication specialist will be glad to discuss those applications with you. He's right there in your section of the Midwest. You need only phone your local Standard Oil office. Or write, Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

What's YOUR problem?

C. L. Daub is the Standard Oil lubrication specialist who helped Multi-clean Products, Inc. solve an important lubrication problem through his recommendation of STANOBAR Grease.

Like all Standard Oil lubrication specialists, he has a broad background of practical experience plus thorough training in Standard's own schools. And like all lubrication specialists, his on-the-job assistance is always available to the industries in the immediate area he serves. He is one of a corps of experienced men who make their headquarters wherever industry is located throughout the Midwest. Call for the services of your Standard Oil lubrication specialist today. When he stops at your plant, be sure to get information on these outstanding products:

STANOIL Industrial Oils—This multi-purpose line of oils provides cleaner operation of hydraulic units, supplies effective lubrication in compressors, gear cases, and circulating systems. One of two grades can replace a wide variety of special oils and lubricants.

CALUMET Viscous Lubricants—On open gears and wire rope, these greases resist washing and throw-off. Their superior wetting ability affords better coating of gears and better internal lubrication of wire rope.

STANORUST Rust Preventives—The eight grades of STANORUST form one of the most complete and effective lines of rust preventives on the market today. Each has been scientifically and specially developed for its intended use. The grades range from a fingerprint remover to a heavy semi-solid that protects against corrosion for years under the most severe outdoor exposure.

STANDARD OIL COMPANY STANDARD *(Indiana)*

mont, Del. Area superintendent of the adiponitrile and diamine areas: **Michael Kwasin.**

K. C. Laughlin. General manager of the textile division, Celanese Corp. of America. He is a company vice president. From associate director of the company's Summit, N. J., research laboratories to technical director of the division: **R. T. Armstrong.**

G. M. Hemmen. Chief engineer of the Union Oil Co. of California.

Harvey H. Morrison. Vice president in charge of production, Stillman Rubber Co., Culver City, Calif. Formerly vice president in charge of production for Los Angeles Standard Rubber Co.

Alfred M. Esberg. Head of the newly organized sales development department of American Potash & Chemical Corp., Los Angeles. He was president of Eston Chemicals, Inc., prior to its merging with American Potash.

D. W. M. Latimer. Faculty research lecturer for the 1952-53 academic year at the University of California at Berkeley. He is a pioneer in low-temperature research and during the war was noted for his work in chemical warfare and plutonium research. From 1941 to 1949, dean of the university's college of chemistry.

E. W. Reid. A newly-elected director of American Locomotive Co. President of Corn Products Refining Co. Recipient of the 1951 Chemical Industry Medal.

Raymond E. Scharmach. Supervisor of analytical control of the Arner Co., Buffalo, N. Y. With the company for 11 years in various technical capacities, more recently in production control.

Henry A. Hill. Assistant manager, National Polychemicals, Inc., Boston. He will be responsible for all manufacturing and technical activities of the company. Comes from Dewey & Almy Chemical Co. Before that he had been director of research for the Atlantic Research Associates

and vice president of the National Atlantic Research Corp.

James S. Coles. President of Bowdoin College in Maine. A research chemist, he was formerly Brown University's dean.

Wilhelm F. Gruber. New staff member of the British Columbia Research Council whose laboratories are located on the campus of the University of British Columbia. Former professor of chemistry at the University of Vienna.

A. B. Tillman. General superintendent of the alkali division at the Painesville, Ohio, plant of Diamond Alkali Co. Has been general superintendent of the electrochemical division at the plant since 1946. His successor: **Steve Puschaver,** formerly assistant general superintendent. New assistant general superintendent in the electrochemical division: **Richard C. Rahn,** formerly an area supervisor in the electrochemical division.

Fred B. Loeffler. Vice president, American Mineral Spirits Co., Western Div. Los Angeles. With company since 1948. Prior to that, with Gulf Oil for fourteen years.

Hans Stauffer. Executive vice president, Stauffer Chemical Co. Has been a vice president and general manager of the company since 1941.

William A. Hart. New president, Audit Bureau of Circulation. Director of advertising, Du Pont.

Max R. Oberdorfer. President, St. Helens Pulp and Paper Co. in Oregon. Has been executive vice president and manager.

OBITUARIES

H. A. Mason, 58, assistant to the manager of laboratories for the General Petroleum Corp., died October 7. He joined the company in 1917 as a chemist. Graduate of the University of California.

Gustavus J. Esselen, 64, a vice president of the U. S. Testing Co. and director of its Esselen Research Division in Boston, died at his home in Swampscott, Mass., on October 22. Doctorate from Harvard.

Industrial Notes

NEW COMPANIES

Western Phosphates, Inc., to produce concentrated superphosphates and phosphoric acid at a new plant in Garfield, Utah. Most of the output of the plant, to go on stream within a year, will be sold as fertilizer. The company, with $5 million capital, is 50 percent owned by Stauffer Chemical Co., and 25 percent each by Kennecott Copper Corp. and American Smelting & Refining Co.

Equipment & Controls Engineers, Inc., Pittsburgh, to specialize in the designing and building of complete coordinated process controls. Walter F. Gieryk has been named president.

Organic Intermediates, Clark Township, N. J., to serve as a clearing house for the sale of dyestuff intermediates manufactured by the smaller dyestuff concerns. The company will also act as sales agent for chlorophyll and derivatives manufactured by the Chlorophyll Corp. of America.

Rutley Industries, Inc., New York, to analyze metal finishing problems, prescribe the correct chemical formulas and produce them in bulk for the users. The concern has been founded by Charles A. Gerber and Arnold A. Tannenbaum.

Eclipse Fuel Engineering Co., of Canada, Ltd. to handle sales and service on the parent company's (Eclipse Fuel Engineering Co. of Rockford, Ill.) products in Canada.

Ferro Enamels (Japan) Ltd., Osaka, Japan, to manufacture porcelain enamel flake. The company is a subsidiary of Ferro Corp., Cleveland.

NEW SERVICES

National Safety Council, Fertilizer Group–Statistics and salient data on what type of assistance in accident prevention would be most valuable to your plant. These will be available if the industry cooperates in supplying data which is now being collected. Questionnaires have been sent to some 600 members of the fertilizer group and it is strongly urged that they be filled in and returned.

NEW LOCATIONS

Fritzsche Bros. of Canada, Ltd., supplier of essential oils, aromatic chemicals and basic perfume and flavoring raw materials, has moved to a new building at 81 Northline Rd., Toronto.

Monsanto Chemical Co. has moved its organic chemicals division to 800 North 12th Blvd., St. Louis.

Carbide and Carbon Chemicals Co. has moved its Houston district sales office to 1100 East Holcombe Blvd.

W. C. Dillon & Co., instruments manufacturer, has moved to a new plant at 14620 Keswick St., Van Nuys, Calif.

Case Chemical Co., Cleveland, which in addition to chemicals handles machinery, machine tools, foodstuffs and dyestuffs, has changed its name to Case International Co.

J. T. Baker Chemical Co. has moved its Chicago warehousing facilities to new and expanded quarters at 2509 West Cermak Rd.

NEW LINES

W. S. Shamban & Co., Culver City, Calif.–Three new series of Kelon-T (Teflon), Kelon-F (Kel-F, fluorothene), nylon and polyethylene O-rings for special sealing applications where elastomeric O-ring compounds are unsatisfactory.

Tensolite Insulated Wire Co., Tarrytown, N. Y.–High temperature hook-up wire insulated with Du Pont Teflon. They are available in fourteen colors.

C.E.N. Machine Products, Inc., Springfield, Ohio–Chemical products and germicides through the acquisition of Hiland Chemical Products, Inc.

NEW REPRESENTATIVES

Dow Chemical Co., Midland, Mich., has appointed Royston Laboratories, Inc., Blawnox, Pa., distributors for Dow magnesium anodes for the protection of underground and underwater structures.

Dewey and Almy Chemical Co., Cambridge, Mass., has appointed Martin, Hoyt and Milne, San Francisco, as exclusive West Coast sales representative for its organic chemicals division.

Hanna Engineering Works, Chicago, has appointed two new sales representatives to handle distribution of its air and hydraulic cylinders and control valves. They are: Haldeman-Langford, St. Paul, Minn.; Scott Equipment & Engineering Co., Indianapolis.

American Resinous Chemicals and **American Polymer Corp.,** Peabody, Mass., have appointed G. S. Robins & Co., St. Louis, as their representative in eastern Missouri, southern Illinois, western Tennessee and Arkansas.

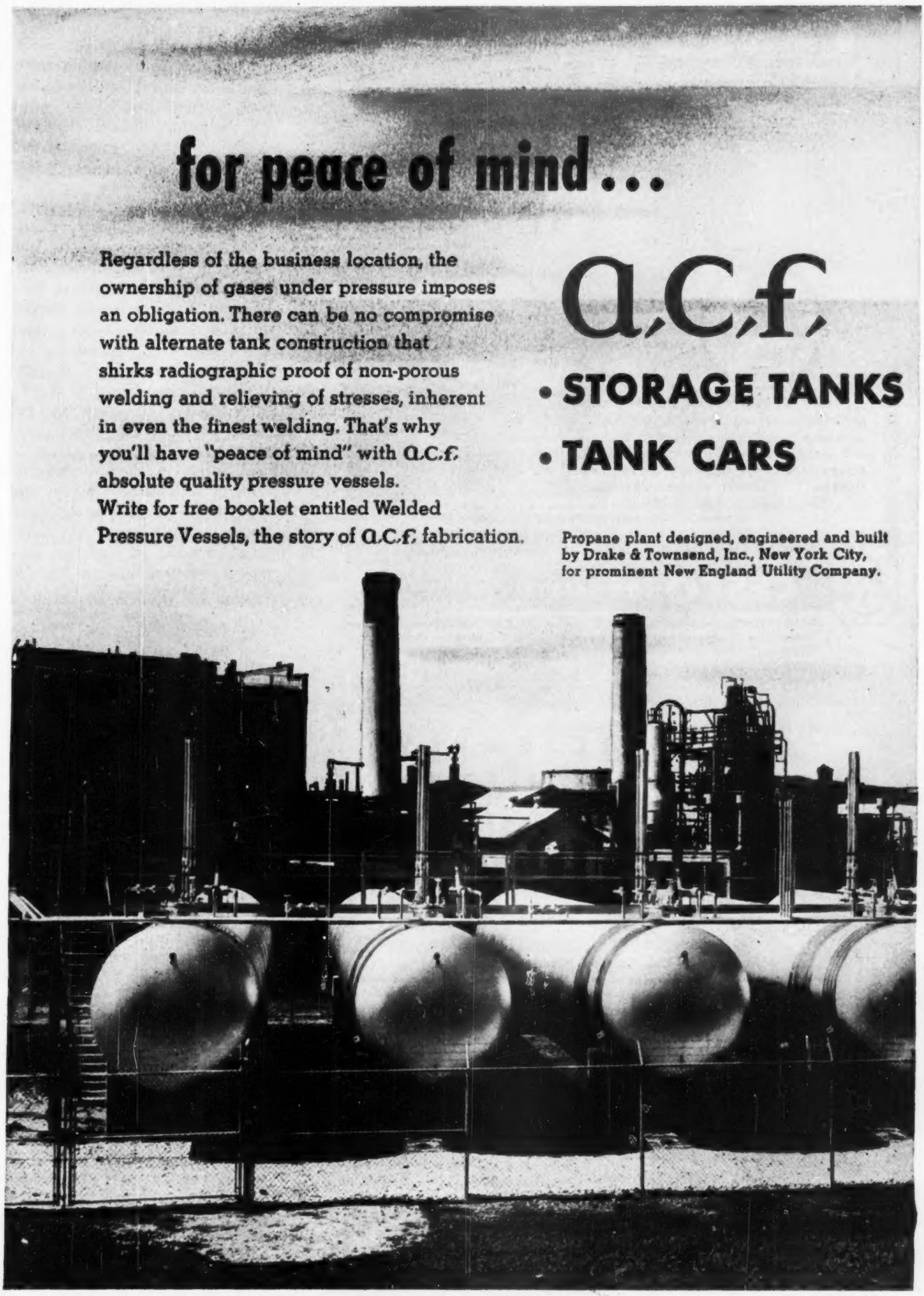
Hammel-Dahl Co., Providence, R. I., manufacturer of automatic control equipment, has appointed James E. Dyer Co. of Tulsa and Oklahoma City as additional sales and service representatives.

Insul-Mastic Corp. of America, Pittsburgh, is now represented in Hawaii by the firm of Craig & Pullen, Honolulu.

Hilton-Davis Chemical Co. has appointed two technical sales representatives to handle its line of flushed and dry colors. They are Thompson-Hayward Chemical Co., St. Louis and J. C. Ackerman Co., Pittsburgh.

Specialized Instruments Corp., Belmont, Calif., manufacturer of

(Continued)



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preparative and analytical ultracentrifuges and electrophoresis instruments, has appointed Analis, Namur, Belgium, its exclusive agent for Belgium, France, Holland, Western Germany, Switzerland and Luxembourg.

Ciba Co., New York, has appointed Furane Plastics, Inc., of California as regional sales agency for its Araldite epoxy resins for adhesive uses. Furane will cover California, New Mexico, Washington and Oregon on a non-exclusive basis. This move augments appointment of Chemotec Division of Eutectic Welding Corp., Flushing, N. Y., as national sales agency for the resins.

Kinney Mfg. Co., Boston manufacturer of high vacuum pumps and rotary liquid pumps, has appointed Harris Pump & Supply Co., Pittsburgh, Pa., as its exclusive sales representative in western Pennsylvania and West Virginia.

W. H. Loomis Talc Corp., Gouverneur, N. Y., has named Whittaker, Clark & Daniels, Inc., New York, as distributor of its fibrous talc to all industries except ceramics.

Specialized Instruments Corp., Belmont, Calif., has appointed Hawksley & Sons, Ltd., London, as exclusive agent for Great Britain. Hawksley will handle sales of analytical ultracentrifuges and electrophoresis instruments.

NEW FACILITIES

Metal Goods Corp., St. Louis, Mo.—New offices and warehouse being built in St. Louis to handle large stocks of aluminum, steel, stainless, brass, copper, fittings.

Bridgeport Brass Co. of Pennsylvania—A warehouse in Philadelphia under the direction of David F. Snow.

International Minerals & Chemical Corp., Chicago—A $1 million expansion announced for its potash division's Niagara Falls plant which will increase production by about 25 percent.

Berkshire Chemicals, Inc., New York—The facilities of Innis, Speiden & Co., New York distributor of heavy

chemicals and white goods, which Berkshire has purchased. The gum, wax and insecticide departments of Innis, Speiden had previously been sold to other interests and will no longer be associated with the Innis, Speiden name.

Houdry Process Corp., Philadelphia–A plant at Paulsboro, N. J., for the manufacture of Type 3 Catalyst to be used in Houdriforming operations for upgrading naphthas to high octane gasolines, and the production of aromatics.

Nuclear Research and Development, Inc., St. Louis–A branch laboratory and sales office in New York. The field office offers industry aid in tackling production and development problems which can be solved using the isotope technique.

D. J. Murray Mfg. Co.–A new building for its plant in Wausau, Wis., which manufactures paper mill equipment, unit heaters, blast coils.

Carpenter Steel Co.'s alloy tube division in Union, N. J.–A mill addition to be completed by late 1953 which will increase production capacity by 40 percent.

Jefferson Chemical Co.–Two new buildings which will comprise a \$500,000 addition to the company's research laboratories at Austin, Tex.

Claud S. Gordon Co., Chicago–A plant just opened at Richmond, Ill., for the manufacture of thermocouples, pyrometer accessories, specialty instruments and metallurgical testing machines.

Pittsburgh Plate Glass Co.'s new fiber glass division–District sales offices in Chicago and Detroit. The offices will be headed by Charles B. Keown and Charles E. Barby, respectively.

Rohm & Haas Co. of Canada Ltd., Montreal–A chemical plant to be built at Scarboro, a suburb of Toronto. The plant will cover 20 acres and is expected to cost between \$3 and \$4 million.

Pittsburgh Plate Glass Co., Pittsburgh, Pa.–A paint manufacturing plant at East Point, Ga., near Atlanta. Rated to produce 1.5 million gal. annually, the plant is designed to allow for

future expansion without structural changes. The company's paint and brush division has also double former capacity of its manufacturing facilities in Baltimore for the production of its tapered synthetic brush filament, Neoceta.

R. S. Aries & Associates, New York chemical engineers and economists –Expanded facilities in France through an agreement with Etablissements Barbet of Paris. Barbet is an engineering, equipment and construction firm specializing in process equipment.

W. S. Shamban & Co.–Expansion of its plant in Culver City, Calif., for production of molded and fabricated Kelon-T and Kelon-F fluoroplastic parts.

Monsanto Chemical Co., St. Louis, Mo.–An agricultural and biological research installation at Creve Coeur, Mo.

Raybestos-Manhattan, Inc.–A Houston warehouse which offers larger quarters with ample stocking facilities for servicing the expanding Gulf Coast industrial area.

North American Cyanamid Ltd. – A newly constructed building in Montreal where it has consolidated its offices and warehouses and where it will increase its scope of activities by producing pharmaceuticals and refining aureomycin. It is hoped that the move will make the company independent of imports of many pharmaceutical items from the United States.

Hooker Electrochemical Co., Niagara Falls, N. Y.–A sales office in Chicago headed by Charles Y. Cain.

Barco Mfg. Co., Chicago–A plant in Barrington, Ill., which will be ready for occupancy early in 1953.

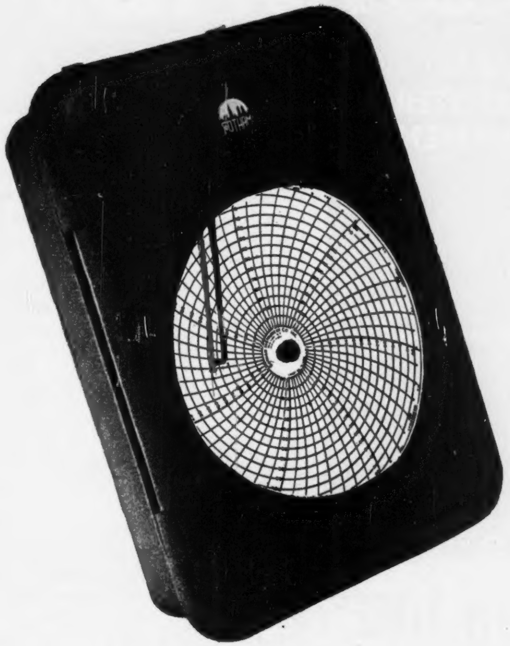
Yardley Plastics of Canada, Ltd., Chatham, Ont.–A $110,000 plant expansion.

Reichhold Chemicals, Inc. – Modern office and laboratory quarters at its South San Francisco, Calif., plant.

B. F. Goodrich Chemical Co., Cleveland–A field sales office in Philadelphia.

(Continued)

CHECK THESE 3 WAYS YOU CAN SAVE WITH THIS MULTI-PURPOSE INSTRUMENT



Here is the most sensible idea you've ever seen in a recorder or controller—an instrument you can change as your instrument needs change, that you can add to, subtract from, or whose functions you can increase or decrease at little or no expense.

✔ **Save money when you add new functions by adding only those new assemblies needed.**

✔ **Save time-delays by making changes on the job site without returning to factory.**

✔ **Save money on inventory. Parts are interchangeable, fit all Gotham Convertible recorders. You can service a whole group with a minimum stock of basic elements.**

What you can do with the Gotham Convertible

Depending on the chart size of the recorder (6", 9" or 12") you can have a 1-2-3 or 4 pen recorder with 14 pressure, temperature and time operation combinations or a recorder-controller with 38 possible pressure, temperature, and time combinations.

SELF-CONTAINED PORTABLE RECORDER

A portable recorder which has a carrying handle, legs and retaining holder for capillary and bulb. Built from Gotham standard elements, interchangeable with other Gotham instruments. 6", 9" and 12" chart sizes. Mercury, Vapor or Pressure Activated. Spring or electric chart drive. See Catalog 400.

RECORDING PSYCHROMETER

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Calaveras Cement Co., San Andreas, Calif.—A $2.5 million plant expansion and modernization program just completed which increases plant capacity by 50 percent.

Tube Turns, Inc., Louisville, Ky.—The Pittsburgh plant of Kerotest Mfg. Co. which it has just purchased.

Merck & Co., Rahway, N. J.—A warehouse in St. Louis.

A. Bamberger Corp. and its affiliate, **American Molding Powder and Chemical Corp.**—A branch office in Columbus, Ohio.

Arthur D. Little, Inc., Cambridge, Mass.—A Midwest branch office in St. Louis, Mo., headed by John R. Kirkpatrick.

American Alcolac Corp., Baltimore—Offices and warehouse facilities in Montreal to facilitate of the company's fatty alcohol sulphate detergents in Canada.

Raybestos-Manhattan, Inc., Passaic, N. J.—Denver, Colo., warehouse and office building. Elton T. Fair, Jr., is in charge of the new facilities.

Savogran Pacific Corp.—A new factory and warehouse in Los Angeles representing an investment of $120,000. The company manufactures paint remover, paint brush cleaner and household cleaner.

Vulcan Copper & Supply Co., Cincinnati—A New York office to represent its engineering, manufacturing and construction divisions.

Diamond Alkali Co., Cleveland—Several processes using fused alkali salts for desanding of both ferrous and nonferrous castings and the cleaning and descaling of stainless steel. The processes have been acquired from Spence Metals Research Co., Pittsburgh, Pa.

Intermountain Chemical Corp. and National Distillers Products Corp. —A $16 million trona plant near Green River, Wyo., about 80 percent complete. Operation is expected to produce 1,000 tons of refined soda ash daily when production is underway in 1953.

—End

OPINIONS

. . *Research in the South*

"The practical research investigator believes that no rabbit is ever pulled out of a hat unless placed there in advance. Our problem is to keep our hats well loaded with rabbits." It is particularly important for technical people in the South, says Director H. McKinley Conway, Jr., of the Southern Association of Science and Industry, Inc., to make known the existence of numerous well-equipped and well-staffed industrial laboratories.

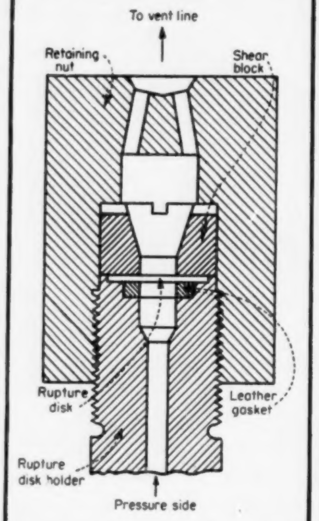
"In the business world, the lack of research facilities is the social equivalent of going without shoes. Since we now have shoes in the South, we ought to make this fact known."

NOTING PROBLEMS

. . . *In Pulping Processes*

What are the most pressing problems in the field of chemical pulping? According to *Tappi*, the big ones are these:

1. Methods need to be developed for measuring morphological and chemical changes that occur during pulping. The industry needs these devices to understand the mechanism and kinetics of wood pulping reactions. Without this understanding, little can be known about characteristics and qualities of pulp.
2. In acid pulping, studies need to be conducted on reaction mechanism and kinetics for bases other than calcium–magnesium, ammonia and sodium for example.
3. In kraft pulping, additional work should be done on mechanism and kinetics of reaction–particularly for high-yield pulping.
4. Largely unexplored are the mechanism and kinetics of reaction in neutral sodium sulphite semichemical pulping.
5. Similarly, studies need to be made on the treatment of chips by aqueous and mineral acid.
6. Little has been done, yet much should be done on multiple-step cooking.



1. How important are temperature conditions at the disk?

2. What kind of disk has the highest shear strength at elevated temperatures?

3. How do silver disks compare with bronze disks?

4. How much strength does silver contribute to a composite disk?

5. What is the ideal material for a rupture disk?

6. Is the relation between shear and yield very important?

When You Design a Rupture Disk

. . . particularly for high temperature service, it may pay you to know the answers to these questions. They are given below, courtesy of Du Pont engineers.

NOTE: *Du Pont has been conducting investigations for some time on the design and application of rupture disks at its Belle Works, Charleston, W. Va. Recently at the Seventh National Instrument Conference in Cleveland, Du Pont's G. R. Prescott reported on the results of these investigations. His paper was contributed by the Industrial Instruments and Regulators Division of The American Society of Mechanical Engineers. Prescott's paper is the basis of this QED feature.*—EDITOR

1 Actual temperature conditions at the disk must be studied before the disk can be properly designed.

Prescott points out, for example, that in one installation, disks were located in the heads of a vessel and heated to the same temperature of the vessel, 240 deg. C. The original disks, built with Type 329 stainless, were designed on the basis of shear strength at room temperature.

In operation, several disks failed at pressures considerably below the design rupture pressure. Experimental bursting tests subsequently showed that the shear strength of Type 329 stainless at 240 deg. C. is about 10,000 psi. lower than its shear at 28 deg. C.

2 The shear strength of a double-hub disk is consistently higher than the single-hub disk at elevated temperatures.

In the course of their investigations, Du Pont engineers compared the performances of a commercial bronze double-hub disk with that of a commercial bronze single-hub. The two disks differed only in web thickness, the double-hub disk being 0.003-in. thicker.

Bursting tests were made in an Aminco Dead Weight Tester over a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FLOWLINE Fittings are made by specialists whose entire efforts are devoted to making corrosion-resistant fittings. The unique features of these fittings are the result of our exclusive method of cold-forming and annealing, which puts them in the best condition for corrosion service. With FLOWLINE fittings, users of corrosion piping can obtain the full economies and efficiencies of butt-welded construction.
The tee shown has typical FLOWLINE features. It is stronger than the pipe with which it is used, is scientifically shaped, with round ends accurately machine tool cut and finished for easy fitting to pipe. Its large throat radii and smooth inner contours reduce pressure loss, minimize flow resistance, corrosion, erosion, and product accumulation.
FLOWLINE Welding Fittings—ells, tees, reducers, stub ends, and caps—are made and normally stocked at strategic points in Schedules 10, 40, and 80—(Schedule 5 also available)—sizes ½" through 12"—in stainless types 304, 316, 347; Monel and Nickel. They are annealed, cleaned bright—stainless fittings are passivated—and marked with type of metal, test number, size, schedule, and wall thickness.
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QED, *cont. . .*

temperature range of 30-300 deg. C. All dimensions were measured to the nearest 0.0001 in., temperature to plus or minus 2 deg. C., and bursting pressures to a plus or minus 25 psi.

The results of the tests showed that the shear strength of the double-hub disk is consistently higher than that of the single-hub disk over the entire range of temperature. At 80 deg. C., for instance, the shear strength of the double-hub disk was 27,000 psi.; the single-hub disk was 26,400 psi. At 300 deg. C., the double-hub disk was 20,700 psi. and the single-hub, 18,800 psi.

Why is one stronger than the other? Web thickness is not likely to figure in this comparison because the difference in grain size between a web thickness of 0.020 and 0.023 in. is not that great. Since all disks are machined from the same plate and are heat treated under the same conditions, Prescott concludes, the difference in design accounts for the difference in strength.

3 At elevated temperatures the shear strengths of commercial bronze disks and silver disks are the same. However, at room temperatures silver disks have a higher strength.

In comparative studies, which were made with single-hub disks, Du Pont engineers found that the difference between the strengths of the bronze and silver disks was 2,800 psi. The shear strength of the composite bronze and silver dropped sharply between 30 and 60 deg. C. Above 60 deg. C., the two strengths were the same. The low yield strength of the fine silver at moderately elevated temperatures probably accounts for the coincidence of the two strengths.

4 Don't design a bronze and silver composite disk based on the sum of the bursting components.

Control of the composite disk, he says, is difficult because rupture pressure decreases sharply between 30 and 60 deg. C. Above 60 deg. C., the silver contributes nothing to the total rupture pressure.

5 The ideal material for a rupture disk should have small plastic range, stability at elevated temperatures, good reproducibility and high creep strength.

Because it has poor reproducibility, untreated commercial bronze is a far cry from the ideal material. Shear strength, for instance, varies 30,000

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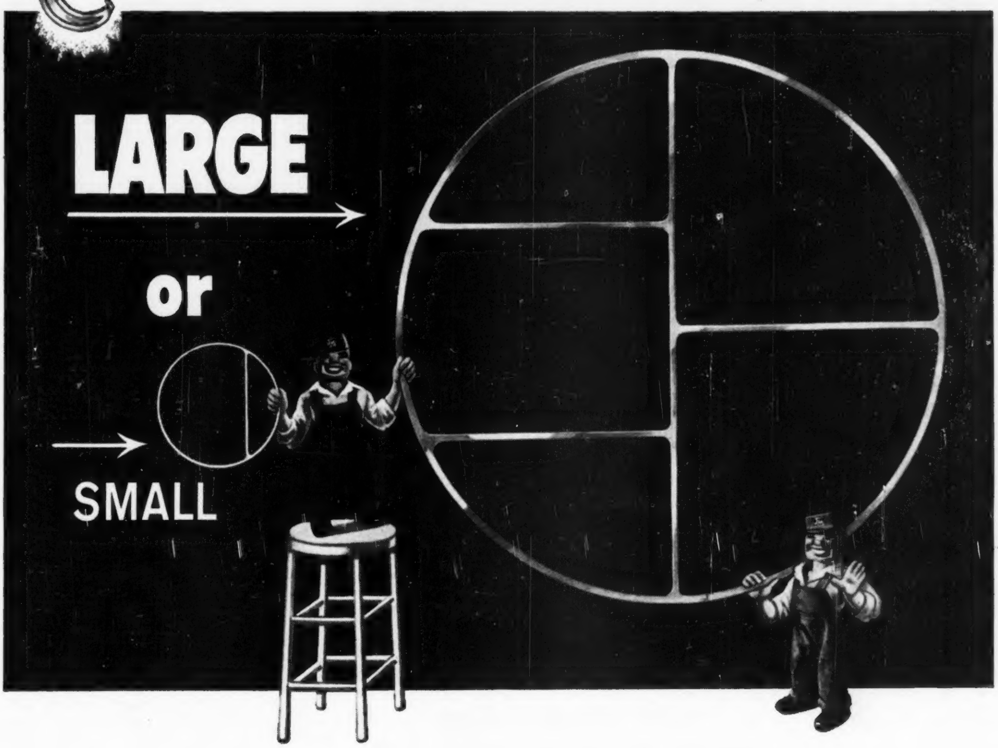

...Goetze Heat Exchanger Gaskets are precision-made for longer service

Whether your requirements call for heat exchanger gaskets larger than 100″ in diameter, or smaller than 10″, you can get the exact size you want . . . hand-tailored to the shape you need . . . simply by specifying "Johns-Manville Goetze."

And because they're *precision-made*, you'll find these better gaskets provide the effective sealing and longer life that make them actually cost less in the long run. Each gasket is carefully constructed in every detail to assure accuracy of fit . . . to provide ample lap widths and uniform rib widths . . . and to prevent trouble-making wrinkles or cracks on the corners.

If you're having trouble with persistent joint leakage and frequent gasket replacements, find out how little it costs to have Goetze Heat Exchanger Gaskets tailored to your requirements. Your blueprint or template will bring a prompt estimate. Address Johns-Manville, Box 290, New York 16, New York.

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QED, *cont. . .*

plus or minus 800 psi.; the corresponding tensile strength, 37,000 plus or minus 2,400 psi. Hardness specification and heat treatment probably account for the wide variation.

However, cold reduction can greatly improve its reproducibility. A 60 percent cold reduction of area, Prescott says, greatly minimizes the variation of mechanical properties; hence narrows the specified ranges. The bronze then could be used either in the as-rolled state, or annealed to a specified grain size.

Cold rolled material has an economic advantage, Prescott believes, and should be entirely satisfactory for general applications where only moderate temperatures are encountered. Reserve your highly stable heat treated alloys, he says, for applications of unusual severity.

6 Pay close attention to the relation between the yield strength (shear yield) and shear strength.

If the plastic range is large, the yield strength is considerably lower than the shear strength. As a result, a disk will yield at pressures well below the design rupture pressure.

According to Prescott, yielding may occur as the result of intermittent pressure surges. It also may be continuous as in creep. Both effects anyway will produce dimensional changes and strain hardening that will alter the original design of the disk.

During the Du Pont investigation, for instance, the original web thickness of a disk had been decreased by 12.5 percent after service at 18,000 psi. and 240 deg. C. for a relatively short time. The 12.5 percent decrease in web thickness corresponds to a 2,700 psi. drop in the calculated rupture pressure. Bursting of similar disks from the same service, however, showed no drop in rupture pressure of the disk. This indicated that the amount of strain hardening had offset the reduced web thickness.

BOOSTING RESEARCH
. . . More Men, More Money

America is spending heavily and employing sizable forces of scientists and engineers in recent years. According to the National Research Council, the nation as a whole spent more than $1 billion on research in 1950 and

employed 165,000 scientists, engineers and technical assistants in its industrial laboratories. This is more than twice the number that were employed in 1940 and almost 10 times the number employed in 1927.

The cost of research in 1952 will approach 1 cent out of each dollar of national income. About 55 percent of this will come from industrial earnings, plowed back to produce more earnings; 45 percent will come from tax dollars.

In the oil industry, companies will spend $130 million for research in 1952. Spurring the industry on, says Gustav Egloff of Universal Oil Products, are the recent developments in petrochemicals. The petrochemical investment, he says, has jumped from $350 million in 1940 to more than $2 billion today and more is being planned.

UPPING PRODUCTION

. . . How?

To make sure our standard of living constantly improves, the U. S. will have to increase its industrial productivity about 45 percent in the next 10 years. Can we do it, and if so, how can we best do it? We can make it, but according to the analysis made by F. R. Benedict, assistant engineering manager, Industrial Products Division of Westinghouse, there is only one way to reach that goal—by more intensive technological development. Considering the difficulties that will crop up, it will be no mean achievement.

Speaking at a recent meeting of the AIEE, Benedict claimed that there are five possible ways for the U. S. to increase its production: (1) lengthen the working day, (2) speed up the worker, (3) improve working efficiency, (4) improve management and organization, and (5) develop our technology.

1. We could increase output by operating machinery longer during a working day, but such a move has definite limitations. We do not have the labor force to fully man our productive facilities; we do not have enough manpower to fill out a two, let alone, a three shift-a-day schedule. The labor force will gradually increase, but it will not be enough.

We could increase the length of the working day, but it would probably not appreciably increase production. If the human body is worked too long,

efficiency is impaired. With such a plan, any gain, experience shows, is largely temporary.

2. We could speed up the worker. But in our highly mechanized factories, it could only be done by speeding up processing or operations, which may not be practical. Also, there is a strong social trend away from just this sort of move.

3. We could improve personal working efficiency. However, the application of labor-saving machinery has been receiving great attention in recent years throughout all industry. As a result, a high proportion of our production tools are already electric powered.

In some cases, we could get more production by replacing manual operations with automatic ones. Undoubtedly, by giving high priority to product planning to reduce labor content, we could make some gains in over-all production.

4. We could improve management and organization. As a matter of fact, management will have to organize to make its production count anyway. With a shortage of labor, intensive study will have to be given to the reduction of labor content per unit of production. Probably more cost reduction programs will have to be instituted.

For efficiency's sake, the activities of engineers, who are already in thin supply, will have to be organized and planned. Continuous effort will have to be made to simplify designs to reduce engineering content.

For economic production in some products, decentralization or complete separation from mixed manufacturing operations will be imperative. Decentralization in many instances will be necessary in order that industry may keep up with the times, which will definitely change more rapidly than they have in the past. On the whole, however, we can expect only a modest increase in production from this approach.

According to Benedict, before we can get results from our best method —intensifying technological development—we will have to increase pilot operations, plow unprofitable facilities under and start up new, and make more thorough studies of a product's life.

A product's life is going to be particularly important because the supply

of many of our essential materials of construction is critically short. We need to look carefully at our production picture and decide whether we have in our designs the best economical mix and type of materials. Then again, it might be to our long-range advantage to reduce the active life of some products in order to lower costs.

REALIGNING RESEARCH

. . . A Current Need

Because of present inadequacies, industry should take on more general research, Cyril Stanley Smith believes. Cyril Smith is director of the Institute for the Study of Metals, University of Chicago.

Working outside their field, the universities can not do a good job with general research. "The universities should admit their failure," he said, "and recognize the fact that better facilities for applied research exist at places like Battelle and Mellon Institutes."

The universities should concentrate on more basic fields of knowledge, Smith explains. "University men must ever seek new concepts and develop methods of attacking the new. In the past it has been a social necessity that the universities do a great deal of research . . . for the simple reason that no one else was doing it. Their partial inadequacy in this field was made evident by the spectacular growth of the great laboratories doing sponsored research."

Smith admits that industrialists may not like spending money for academic research. However, he believes that industrialists can be convinced of the practicality of general research. "I believe most strongly that it is the tiny fraction of research that is done for understanding alone that in the long run will have the greatest influence and be the most profitable."

In industry, general research can best be done cooperatively, he says. On the whole, cooperative research has been arranged better in Europe than in the U. S. Here cooperative research tends more to the work nobody is interested rather than work in which everybody would find valuable. A particularly important field that should be supported on an industry-wide cooperative basis is the gathering

of basic data on structures, phase diagrams and thermodynamic properties—the kind of stuff one looks for in a handbook.

COOLING WATER

. . . Useful Slime

Conditions for growth of bacteria in cooling towers are ideal—warmth, light and air are all available and the wooden laths become covered with nitrifying slime. By oxidizing the ammonia and organic impurities in the water, the laths behave in the same way as a mature percolating filter on a sewage works. Only within the last year or two have engineers realized that cooling towers have become the seat of such intense biological activity.

Obviously it's desirable to make full use of the oxidizing capacity of the towers, otherwise the oxidation may have to be done by chlorine for example. But, how can you make the best use of this capacity?

British engineer H. Pirie suggests . . .

"Ideally, the incoming cooling water, particularly if it is high in ammonia, should be fed directly into the towers. This is not always practicable and of course involves pumping costs. A suitable compromise may be to position the inlet at the inlet end of the cooling tower pond so that some oxidation does occur in admixture with the highly nitrified tower effluent.

"The biological life in the towers must not, of course, be allowed to become so luxuriant as to interfere with the distribution of water over the laths. In practice this does not often occur, the small amount of chlorine going forward from the condensers being usually sufficient to prevent excessive growths."

MAKING SOAP

. . . Division of Opinion

Soap bleached by potassium persulphate may turn dark afterwards, but it is not the fault of the persulphate, argues J. Davidsohn in *Soap* (June, 1952), the official organ of the South India Soap Makers Association. "I am in a position to positively prove by various tests that this characteristic can be noticed not only in soaps bleached by potassium persulphate,

QED, *cont. . .*

but also in soaps bleached by any other process, and moreover also in unbleached soap; this feature is only a natural drying out of the soap."

OBTAINING MINERALS

. . . From the Sea

The sea is a vast storehouse of mineral wealth that man is just beginning to tap. For all practical purposes, writes Vice President Charles F. Kettering of General Motors Corp. in October's *American Engineer*, the mineral resources of the sea are inexhaustible.

"We are just beginning to mine the sea in a very small way," he says. "Bromine, a product we get from mining the sea, originally had only a small demand for photographic work and bromo seltzer. The entire world produced only about 800,000 lb. a year.

"When we needed more bromine badly to make ethyl gasoline we realized that 800,000 lb. would not do us any good because we needed at least 20 million pounds per year. Everyone told us we could not get it. It just was not available.

"Now we know that there is one pound of bromine in ten tons of sea water. Last year we took 125 million pounds of bromine out of the sea at Freeport, Tex. To get it, we pumped 0.1 of a cubic mile of water. There are 320 million cubic miles of sea water. Here is a natural resource we do not use up, because long before it is pumped out, it is running back.

"We are beginning to take magnesium out of the sea. There is more potassium in the ocean than there is bromine. As we learn to mine the sea, we are not going to be shy of essential minerals at all," Kettering concludes

DISTILLING FATTY ACID

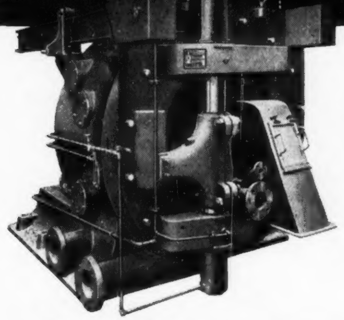
. . . Four Suggestions

In working up a fatty acid distillation system, a designer tries to hold down temperatures and minimize holding periods during the time the fatty stock is hot. To help him do this, R. H. Potts, Armour & Co., who presented a paper before the recent national meeting of the AIChE in Chicago, suggests four effective practices:

(Continued)

REINEVELD CENTRIFUGALS

PROVIDE AUTOMATIC, CONTINUOUS PROCESSING



Reineveld Centrifugals provide automatic, economical dewatering of both *slow-draining* and *quick-draining* materials plus process flexibility for washing, classification, steaming and selective solubility.

The listings on this page show how Reineveld Centrifugals combine the low operating cost and automatic production of the "continuous" process with the flexibility and versatility of the "batch" process to provide the answer for most processing problems.

REINEVELD "Continuous" CHARACTERISTICS

(*for quick-draining crystals*)

Reineveld Centrifugals:

provide product quality not related to operator's skill.

provide continuous processing.

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handle products where time is important to accomplish desired result.

You can count on Reineveld's vast experience to help you with your centrifuging problem. Write for Booklet 9-RC-2.

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(*for slow-draining crystals*)

Reineveld Centrifugals:

are capable of handling a large range of slow or fast-draining crystals. High salvage values for re-location.

provide thorough crystal wash.

provide minimum wash liquor/ lb. product.

can discharge solids as fluffy, dewatered material or as a slurry for subsequent processing.

provide impurity removal by selective solubility.

provide simultaneous dewatering and fines (slimes) removal.

Heyl & Patterson's complete laboratory facilities are available to test your material.

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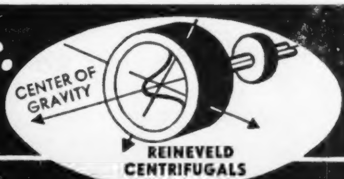


55 WATER STREET · PITTSBURGH 22, PA.

QED, cont. . .

1. Provide good vacuum equipment for the system to permit operation at low absolute pressures.
2. Minimize the pressure in the tower and tower reboiler by careful design and generous proportioning of vapor passages.
3. Make use of stripping steam as inert medium to reduce partial pressure of fatty acid needed for boiling.
4. Minimize liquid hold-up.

The best type of vacuum equipment, says Potts, is steam jet air ejectors. And to obtain best efficiency, dry steam should be provided. It is also desirable to steam-trace part of the diffuser and throat of the booster ejector. If this precaution is not taken, both congealed fatty acids and ice could partially block the vapor passageway.

By paying careful attention to detail in the design of reboiler, trays, vapor lines and condenser, it is possible to hold down pressure drop in the tower and reboiler. Bubble trays and reboilers, says Potts, should be proportioned to minimize any liquid head resistances to vapor flow.

Bubble caps with their vapor risers should have interrelated proportions. These proportions are far more important at low absolute pressures than at higher pressures. It should be possible to obtain an average pressure drop of about one millimeter of mercury per tray.

Entrainment eliminators should be of low pressure drop types if located between a condenser and its booster ejector. In short, Potts says, all items of equipment in the vapor path should be tailored for high vacuum service.

The higher the temperature, the greater the degradation of the feed stocks per unit of time. Based on his experience, Potts considers decomposition quite active above 250 deg. C. Recent tests, he says, show reduction of 4 points in acid value and 3 points in saponification value when animal fatty acids are held at this temperature for several hours.

As for materials of construction, Type 304 stainless steel, Potts points out, originally was thought to be adequate for fatty acid stills. This belief, he says, was abruptly changed by commercial operation. Type 316, containing approximately the same constituents, but with the addition of molybdenum (content of 2.5 percent) performs better. —*End*

CONTROL
Continued from page 195

to that of induction in electrical circuits or to that of inertia in fluid or mechanical processes.

In these illustrative examples, the effect of fluid inertia has been ignored. Inertia of process fluids is generally small compared to other process effects. In the absence of induction and inertia, none of the processes illustrated, considered as isolated systems, will oscillate (hunt). Oscillation of an isolated system requires the opportunity for the conversion of potential to kinetic energy, and vice versa. For this opportunity to exist, either induction or inertia must be present in a system simultaneously with capacity. This follows from the law of conservation of energy $KE + PE = C$.

To permit mutual conversion of these energies into each other, the kinetic-energy factor KE must be present in the form of induction or inertia, and the potential energy factor PE must be present in the form of a capacity in which the potential energy may be stored. In the absence of either of these factors, oscillation is not possible. Oscillation would become possible if some end effect from the process were fed back into an earlier part, thereby setting up a closed loop. In this case, a resonant condition might occur, which could produce sustained oscillation. None of the processes analyzed is so handled.

This also means that if inertia is appreciable as compared with other process conditions, some of the processes described might be unstable and oscillate continuously under the influence of the energy of the entering fluids. Such cases are not considered in this discussion.

The reaction curves* show the reaction to a step change in one of the process functions. From a condition of equilibrium, an arbitrary instantaneous change is made in one or more of the factors affecting the measured variable, so that a new equilibrium will result. For simple processes, the reaction curves will be nearly identical, regardless of which factors are changed; but for complicated processes, with multiple com-

* In these curves P is pressure, R is resistance, h is head and Q is flow rate. No substript, or a subscript number, means value of the quantity in a particular location at any time. Subscript 0 = initial value, subscript e = final value.

binations of capacitance and resistance, the reaction curves differ greatly for disturbance of different factors.

Fig. 4 is the generalized prototype of a single-capacity process. It responds to an upset or correction at maximum rate of change, which attenuates to equilibrium on an exponential curve. As the ratio of capacity to throughput decreases, the slope of the initial curve of departure increases, until the limit would be found in an incompressible fluid. Depending on the steepness of this slope, this type of process falls in either Class 1 or 3, with respect to ease or difficulty of automatic control.

Fig. 5 shows the hydraulic equivalent of Fig. 4 and the reaction curves are of identical type. The equivalent of the incompressible fluid situation in Fig. 4 would be reached in Fig. 5 if the area of the tank became zero. Fig. 6 shows a process having practically identical reactions, the difference being that the height of liquid in the tank has no effect on the rate of flow of liquid entering.

Fig. 7 shows how the reaction curve becomes more complicated with process complication. The different reaction curves show that the class of process this example will fall in will depend on the source of upset. If the upset occurs in either the outlet resistance of the second tank or the interconnecting resistance, the process will fall in Class 3. If the upset occurs in the inflow, it will fall in Class 4. Note that if the interconnecting resistance is changed, equilibrium will come about at the initial value without any corrective action, although a serious transient deviation occurs.

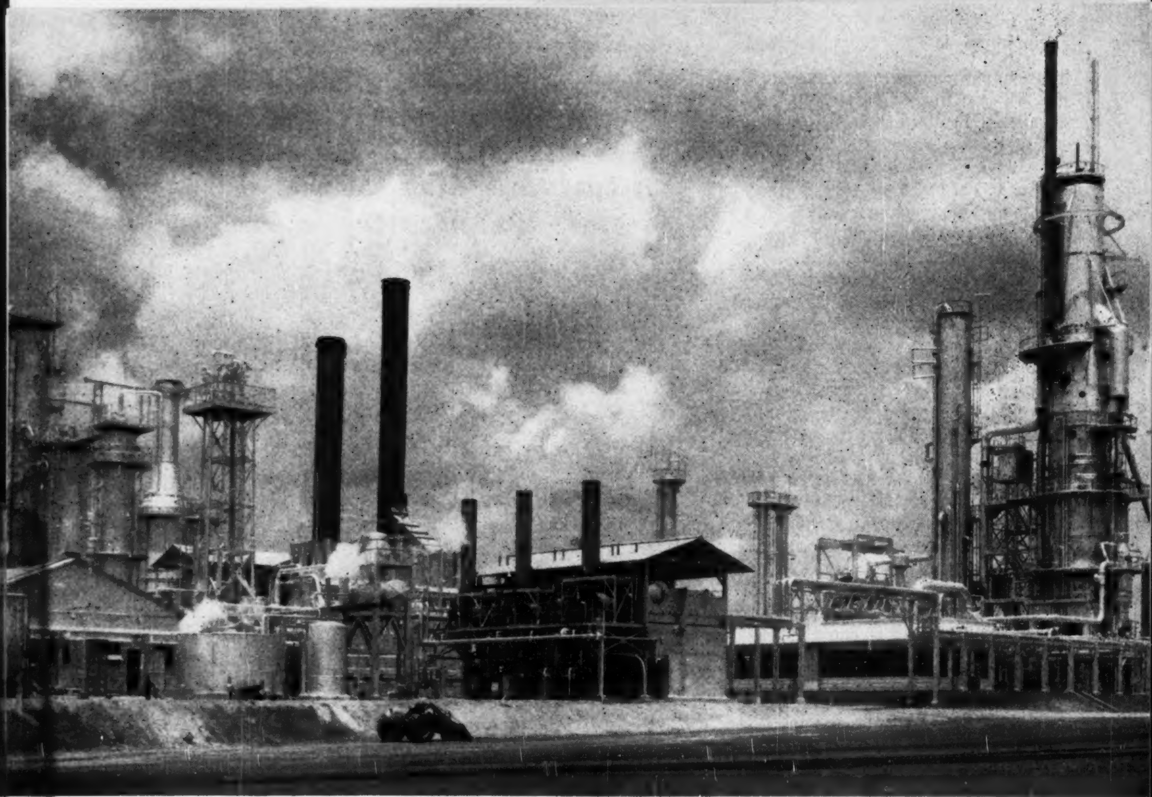
Fig. 8 shows how the complications of process reactions extend as the process becomes more complicated and illustrates the effect of changing either interconnecting resistance.

Top-fed tank combinations produce very nearly the same process effects as dead time, and a sufficiently large number of interconnected capacitances will have the same effect.

Figs. 9 and 10 show the results of combining top-fed and interconnected systems.

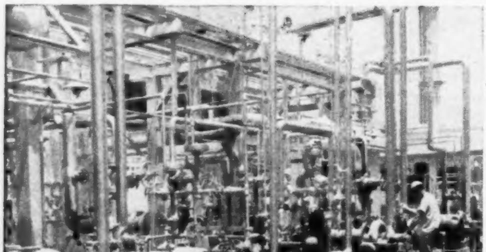
Effects of dead time are closely approximated by the combinations shown in Figs. 8 to 10, inclusive. Oldenbourg and Sartorius† have shown this relation very clearly. —*End*

† "The Dynamics of Automatic Control," by R. C. Oldenbourg and H. Sartorius, translated and edited by H. L. Mason, ASME Publication, 1948, 276 pp.

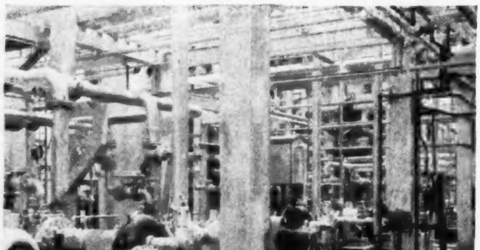


McMurrey Refining Company, Tyler, Texas, installed G-E mechanical-drive turbines throughout their plant to help assure continuous capacity output of 5000 bbls. per day.

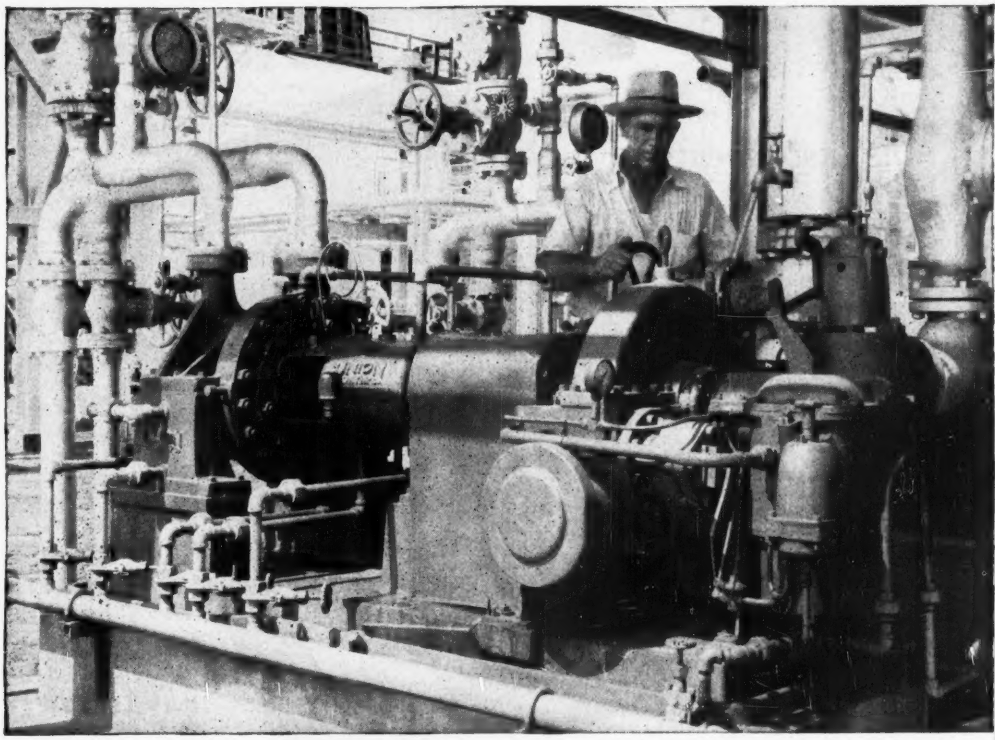
G-E Turbines Save Maintenance,



G-E turbines and motors are paired at McMurrey Refinery to utilize large steam supply efficiently. When process steam demands decrease, surplus steam is economically diverted to turbine drives. These Type DP turbines range from 8 hp to 41 hp.



Shown here is part of a row of ten General Electric Type DP turbine drives and motors, ranging from 9 hp to 48 hp. The many interchangeable parts on these turbines make stocking of spare parts an economical matter.



Maintenance personnel at the refinery have found this General Electric Type DP mechanical-drive turbine, like the many others at the refinery, easy to maintain. This 47-hp turbine at McMurrey Refinery drives a boiler-feed water pump.

Inventory Costs at McMurrey Refinery

Installed to improve steam balance, G-E standard turbines, with many interchangeable parts, also cut inventory costs.

The McMurrey Refinery, Tyler, Texas, installed General Electric mechanical-drive turbines to help regulate steam balance. Since process steam demands range from 30% to 70% of available supply, surplus steam is economically diverted to turbine drives.

Time soon proved that General Electric turbine drives have many other advantages. Mr. Dave Hood, Mechanical Maintenance Foreman at the refinery, states, "With these turbines on the line now for over a year, we're happy to report that they are extremely easy and economical to maintain, requiring very little of our time for maintenance."

Mr. Hood also said, "Since we have quite a few different sizes and ratings of turbines here, we're particularly pleased with the great number of interchangeable parts on these turbines. It certainly cuts down our inventory problem." Interchangeability of a great majority of the replaceable parts (regardless of hp rating) is a big feature with G-E standard turbine drives, which are paired with motors throughout the refinery to help assure uninterrupted service.

Call in your G-E sales-engineer or write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." Section 252-59, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

Chemical Engineer's Bookshelf

Edited by Lester B. Pope

Increased Total Worth

SYNTHETIC METHODS OF ORGANIC CHEMISTRY, Vol. VI. By W. Theilheimer. (Interscience Publishers, New York. 401 pages. $12.90.

Reviewed by Edgar A. Steck

The assiduous efforts of Dr. Theilheimer have continued, and the newer developments in organic synthesis have been covered into 1951. Earlier volumes in this elegant series have been integrated into the system and indexing of this volume, thus increasing the total worth. The over-all picture of the work is such that "Theilheimer" will be found to have value in the development as well as in research groups through clear and concise information on improvements in methods of synthesis. Some procedures have been given in sufficient detail that direct use may be made. The care to ensure freedom from errors has produced fine results, even with respect to the difficult matter of nomenclature, which is clearly consistent with Chemical Abstracts usage. It is only in the appearance of *J* for iodine, and O for o that one can find even the slightest cause for chiding. A number of firms have continued to express their approval, through financial support, of the painstaking efforts which Dr. Theilheimer has lavished upon a work well conceived and splendidly executed.

Lucid

VALENCE. By C. A. Coulson. The Clarendon Press, Oxford. 338 pages. $5.

Reviewed by F. C. Nachod

A coherent doctrine like chemistry could never have been built up without the concepts of bonds and valence. Yet the theories of valence have progressed tremendously in the past 25 years and it is most appropriate to have now an accounting of what we know.

Our thinking about valence makes use of two approximations, referred to as molecular orbital and valence-bond methods. Dr. Coulson uses both approaches and points out their relative advantages and shortcomings (particularly in Chapter 6). He begins with simple molecules and leads the reader to the more complex polyatomic types. Non-metallic solids, metals, hydrogen bonds and other topics form the subject of the last three chapters.

The present text is not only lucidly written but is a work of art as we frequently find it and have come to expect it from our Oxonian friends.

This is one of the rare instances that a reviewer can recommend a book unequivocally.

Fairly Comprehensive

PHASE RULE. Ninth edition. By Alexander Findlay. Revised and enlarged by A. N. Campbell and N. O. Smith. Dover Publications, New York. 512 pages. $1.90 (paper), $5 (cloth).

Reviewed by H. Steinhauser, Jr.

Findlay's "Phase Rule" is a descriptive account of phase equilibria rather than a thermodynamic or highly mathematical treatment. It assumes a knowledge of physical chemistry and thermodynamics. Principles and applications are introduced by means of specific examples. A valuable feature is the detailed discussion of phase changes when external conditions are changed. These give the reader an insight to the meaning and utility of the phase rule.

The new edition is an admirable extension and revision of the older ones, clearly written for the most part and well diagrammed. The few criticisms which could be made do not apply to the book as a whole and are not the proper subject for a short review.

The material on binary and ternary systems has been greatly expanded over that of the eighth edition. The chapter on binary liquid-solid equilibrium is particularly well presented. The authors are careful to distinguish between truly condensed systems and those in which the presence of the vapor phase has little effect on the solid-liquid equilibrium. The evolution of the phase diagram is clearly built up from the simple eutectic to the more complex types.

Two chapters cover vapor-liquid equilibrium in binary and ternary systems and its relation to distillation. The chapter on binary equilibrium is only a slight extension over what would be expected from a course in physical chemistry except for the sections on partially miscible systems. The chapter on ternary equilibrium is particularly commendable. It includes complete and partial miscibility and discusses the path of residue composition during distillation.

Four, five and six component systems are discussed, particularly with regard to methods of graphical presentation.

Metastability and suspended transformation are discussed at length in relation to many different phase changes. This important subject might readily be overlooked in a purely thermodynamic treatment.

The connection between free energy data and equilibrium compositions is shown for several cases in the appendix. This connection is always assumed and rarely illustrated.

This book will no doubt continue to be a standard and welcome text for the usual graduate course in phase rule. It is fairly comprehensive and guides the reader over some of the common pitfalls.

Preparative Biochemistry

BIOCHEMICAL PREPARATIONS, Vol. 2. Edited by E. G. Ball. John Wiley & Sons, Inc., New York. 109 pages. $3.

Reviewed by Alex Lesuk

The second volume in this valuable series continues the presentation of completely adequate and verified directions for the preparation of purified or pure compounds of interest to research workers and students in biochemistry.

It differs somewhat from its predecessor in that a major portion is devoted to synthetic methods rather than to isolation procedures. It is to be

hoped that in the screening of compounds for inclusion in future volumes, a greater preference will be shown for those equally important compounds whose preparation is accomplished best by isolation from natural sources.

A welcome innovation in the present volume is the application of biological methods to the synthesis and/or isolation of certain natural products. The preparation of C^{14} uniformly labeled sucrose utilizes a photosynthetic reaction in a leaf and involves the removal of monosaccharide impurities in the product by yeast fermentation. *myo*-Inosose-2 is prepared by the action of a bacterium upon *myo*-inositol. These procedures also serve to illustrate the broad range of manipulative techniques available.

The excellent format is identical with that of the earlier volume. Generally speaking, however, an indication of the advantages of a particular preparative procedure over alternative procedures would be desirable in the sections headed "Methods of Preparation."

In addition to the compounds mentioned above, the preparation of the following is described: cytochrome C, cucurbit seed globulin, oxycasein, phosvitin, lactate dehydrogenase, sodium pyruvate, phosphorylenolpyruvic acid, L-α-glycerophosphoric acid, glucose-6-phosphate, fructose-1,6-diophosphate, DL-epi-inosose-2, inositol monophosphate, DL-glutamic acid monohydrate, L-aspartic acid, glutathione & intermediates, DPNH, phosphorylcholine, oleic acid, methyl oleate and methyl ricinoleate.

The volumes in this series belong on the reference shelves of almost all laboratories concerned with preparative biochemistry.

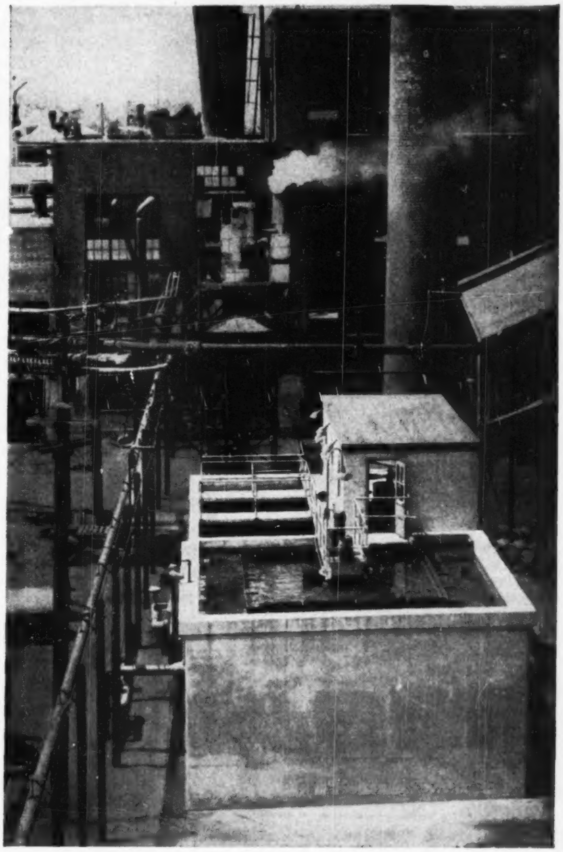
Part I

POLAROGRAPHY. Second edition. By I. M. Kolthoff and James J. Lingane. Interscience Publishers, New York. 420 pages. $9.

Reviewed by F. C. Nachod

The revised and augmented second edition of the fine work of Drs. Kolthoff and Lingane is hardly recognizable as the successor of the original which appeared in 1941. The first volume, now at hand covers theoreti-

This water clarifier plant is really COMPACT



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GRAVER Reactivator

GW 471

cal principles and instrumentation and technique in over 400 pages, which in the first edition had only an allotment of about 250 pages. Application of polarography to inorganic, organic, and biological chemistry and amperometric titrations will form the subject of Vol. II promised for the latter part of this year. This reviewer feels that a recommendation for this fine book is superfluous as every worker in polarography knows Kolthoff and Lingane already. The new edition will quickly replace the earlier one on the shelves and make the work even more useful.

Recent Books & Pamphlets

Subject	Summary	How to Order
Water Supply	Suitability of the water supply in various areas for industrial use is discussed in a series of reports. East south central states, Circular 197, 69 pages. Mountain states, Circular 203, 79 pages. West north-central states, Circular 206, 109 pages. Six more preliminary reports are in preparation.	U.S. Geological Survey, Washington 25, D.C.
Metallurgy	Salient features, advantages and limitations of present-day investment casting processes. Emphasis is on design engineering factors which determine the attainable precision of cast dimension, cleanliness and uniformity of metallurgical structure. Hard cover. 477 pages.	"Investment Castings for Engineers." By Rawson L. Wood and D. Von Ludwig. Reinhold Publishing Corp., 330 West 42nd St., New York 36, N. Y. **$10.**
Heat Transfer	Tables to provide the process engineer with a quick and reasonably accurate means of estimating the amount of heat transfer surface required in heat exchangers, coolers and condensers of a proposed chemical processing or oil refining plant. 43 pages.	"Heat Transfer Tables." By E. N. Sieder. American Locomotive Co., Schenectady 5, N. Y. $3.
Organics	This year's volume, the latest of an annual series, containing satisfactory methods for the preparation of organic chemicals. Full details of all steps in each procedure as well as the range of yields. Covers 43 compounds from abietic acid to 10-undecynoic acid. 119 pages.	"Organic Syntheses Vol. 32." By R. F. Arnold. John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. $3.50.
Water Pollution	Bibliography of representative literature, both technical and nontechnical, published on the problem in recent years. 23 pages.	"Source Materials on Water Pollution Control." Div. of Water Pollution Control, U.S. Public Health Service, Washington 25, D. C.
Sulphur	Annotated bibliography and index map of sulphur and pyrites deposits in the U. S. and Alaska. 48 pages.	Circular 157. By Gilbert H. Espenshade and Carl H. Broedel. Geological Survey, Washington 25, D. C. Free.
Acid Handling	Latest recommended practice for unloading sulphuric acid or mixed nitric and sulphuric acids from tank cars. 9 pages.	Manual Sheet TC-1. Manufacturing Chemists' Assn., 246 Woodward Bldg., Washington 5, D. C. 20 cents.
Thiosemicarbazones	Lists and abstracts patent applications from I.G. Farben and one of its successor companies, Farbenfabriken Bayer, on the production of thiosemicarbazone compounds. Covers 28 patents applied for between 1943 and 1950. 8 pages.	Research Information Service, Bulletin 70. 53 Nassau St., New York 38, N. Y. Gratis.

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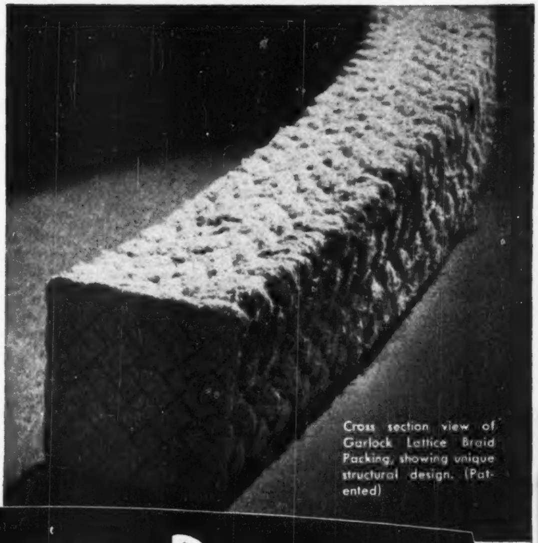

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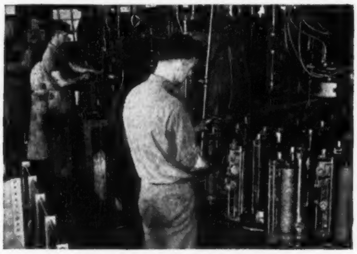

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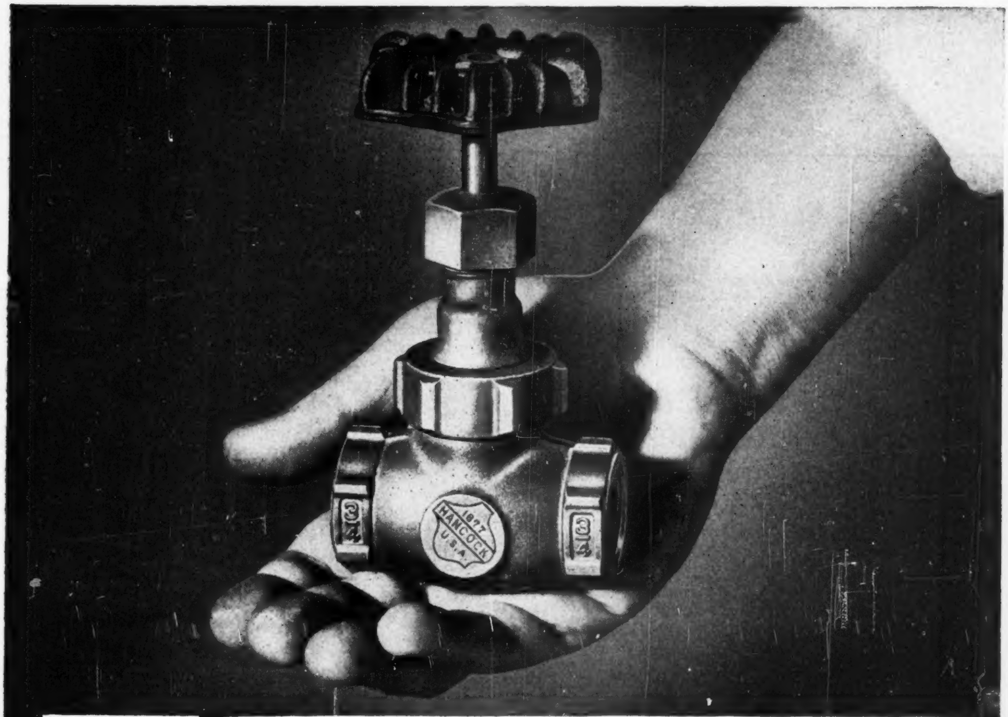
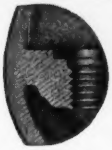
Detergents	. . . use specialized detergents for a wide range of rubber industry cleaning. 24 p.	Oakite Products, Inc., 157 Rector St., New York 6, N. Y.
Spray Dryers	. . . save money in many applications by installing a drying unit. Where and how they can be used. 8 p.	Foster D. Snell, Inc., 29 West 15th St., New York 11, N. Y.
Pumps	. . . find the right cradle-mounted general purpose centrifugal pump for your specific use. Specifications for five basic cradle groups and 17 corresponding pump types. 16 p.	Ingersoll-Rand Co., Dept. C. P., 11 Broadway, New York 4, N. Y.
Area Meter	. . . measure fluid flow of water, kerosene, gasoline, oil, tar, chemicals, distillates, refrigerants. 4 p.	Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.
Instruments	. . . control pressure, temperature, flow and level with a miniature all-electronic system. Photographs, schematic diagrams, dimensional drawings. 6 p.	Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.
Instruments	. . . combine control components to make up systems to accommodate processes in the rubber, chemical, petroleum and other industries. 8 p.	Bailey Meter Co., 1050 Ivanhoe R., Cleveland 10, Ohio.
Fork Trucks	. . . get maximum economy, freedom from repairs and ample power for full load from lift trucks which feature a specially designed heavy duty industrial engine. 12 p.	Towmotor Corp., 1226 East 152nd St., Cleveland 10, Ohio.
Instruments	. . . record and control pH with an automatic system. 4 p.	Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.
Instruments	. . . handle many of your materials testing jobs with a new type of universal testing machine. Describes how the machine can be set up for static, dynamic, impact for torsion testing. 4 p.	Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.
Plant Sites	. . . evaluate the facilities offered by northeast Ohio for your particular requirements for production, distribution and management headquarters. Maps and photographs. 12 p.	Cleveland Electric Illuminating Co., 75 Public Sq., Cleveland 1, Ohio.
Conveyors	. . . find a conveyor for use where pounds-per-hour requirements are small and where there are space restrictions. 4 p.	Carrier Conveyor Corp., Louisville 6, Ky.
Switches	. . . control alternating current circuits in commercial and industrial applications with this company's Micro precision switches. 24 p.	Micro Switch, Freeport, Ill.
Protective Coatings	. . . fill your phosphating requirements. Describes five compounds which can be used to deposit crystalline inorganic coatings on metals. These coatings form a base for almost any type of organic finishes. 4 p.	Turco Products, Inc., Terminal Annex 2649, Los Angeles 54, Calif.
Solvents	. . . promote solvation, flow and leveling, blush retardation, film smoothness and gloss with two new solvents: methoxy butyl alcohol and methoxy butyl acetate. 10 p.	Tennessee Eastman Co., Kingsport, Tenn.
Furnaces	. . . satisfy your needs from a line of general purpose electric furnaces, high speed electric furnaces, recirculating furnaces, electric ovens.	Cooley Electric Mfg. Corp., 38 South Shelby St., Indianapolis 7, Ind.
Pipe	. . . get hold of pipe for weather-exposed and underground systems conveying hot or cold liquids or gases. Steam pressures up to 1000 psi. 4 p.	Durant Insulated Pipe Co., Warren Way and Bay Rd., P. O. Box 88, Palo Alto, Calif.
Plant Site	. . . appraise the advantages of Chicago's Near South Side as a site for industrial research laboratory facilities. 4 p.	South Side Planning Board, 2018 South Calumet Ave., Chicago 16, Ill.
Plastic Coatings	. . . temporarily protect tools, gears and machined parts during processing, storage and shipping with hot-melt, strippable, plastic coatings. 4 p.	Fidelity Chemical Products Corp., 470-474 Frelinghuysen Ave., Newark, N. J.
Communication	. . . provide your plant or office with sound powered communications equipment like this company's Pair Phone System, Multi-service Intercom System and a Master Phone System. Installation information, wiring and dimension diagrams. 6 p.	Wheeler Insulated Wire Co., Waterbury 20, Conn.

—End



EXTRA-TOUGH BRONZE VALVES

FOR LEAK-PROOF SERVICE!



Usual Bronze Valve Diaphragm Construction

Hancock Bronze Valve Diaphragm Construction . . . 125% to 230% Stronger

When you buy bronze valves, get what you want – greatest efficiency, longest service, biggest savings. Extra-tough Hancock Bronze Valves assure *all three* with features like these:

- ✓ "500 Brinell" Stainless Steel Plug Seat and Disc prevent leaks.
- ✓ 125% to 230% Stronger Diaphragm than ordinary bronze valves.
- ✓ Hard-Rolled Bronze Stem (Acme threads) takes the roughest treatment.
- ✓ Long-Lasting, Seal-Tight Packing cuts maintenance.
- ✓ Real Back Seating makes packing easy under pressure. Direct seat between stem and bonnet — away from heat and flow of pressure media.
- ✓ Rigid Body, Bonnet and Bonnet Ring of durable steam bronze withstand installation and service abuse.
- ✓ Cool, Comfortable Handwheel built to operator specifications.

Durable Hancock Bronze Valves are made in sizes from ¼" through 2" – globe and angle types, screwed ends — for 150#, 200# and 300# W.S.P. ratings. Phone your nearby Hancock Distributor for prompt delivery. Remember, Hancocks cost no more than ordinary bronze valves.

When Hancocks go in, valve costs go down.

1877 HANCOCK U.S.A.

HANCOCK VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** WATERTOWN 72, MASSACHUSETTS

MAKERS OF 'HANCOCK' VALVES, 'ASHCROFT GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, AMERICAN' INDUSTRIAL INSTRUMENTS. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

MANNING MAXWELL & MOORE INC. MM&M TRADE MARK

New TRANSAIRE®

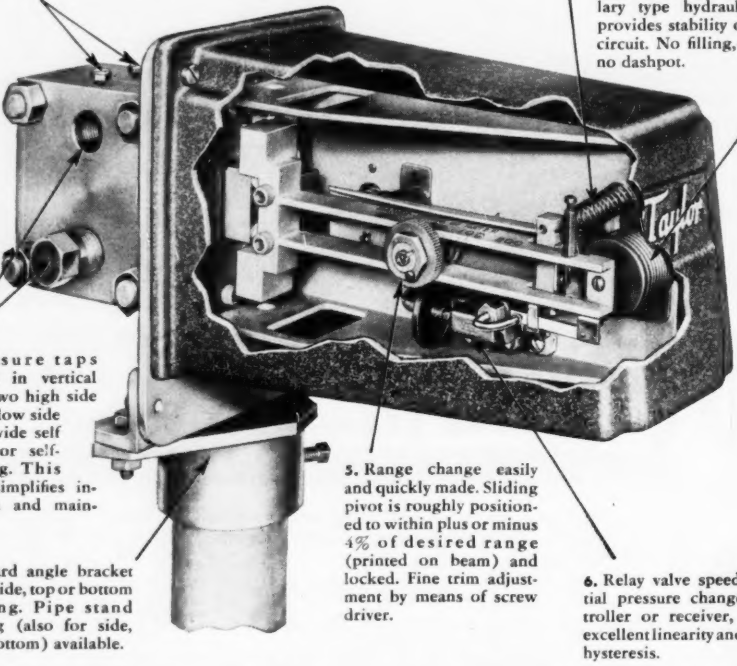
The new Taylor TRANSAIRE® Differential Pressure Transmitter

1. Dry meter operates on force-balance principle. Diaphragm of Teflon coated glass cloth. Body working pressure rating 1500 psi. Available in either forged steel or type 430 stainless steel.

2. Vent screws to provide for total filling in liquid service.

8. Provision for adjustment of range suppression up to 100%.

7. Built-in, trouble-free, capillary type hydraulic damping provides stability of pneumatic circuit. No filling,—no mess—no dashpot.

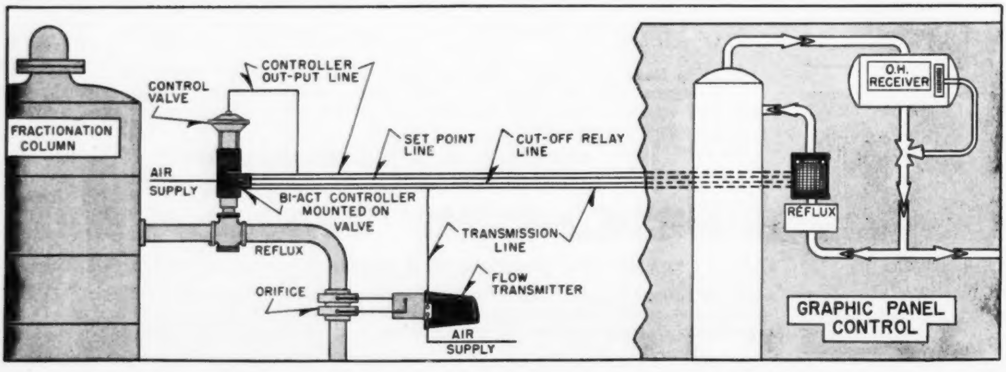


3. Pressure taps mounted in vertical plane. Two high side and two low side taps provide self venting or self-draining. This feature simplifies installation and maintenance.

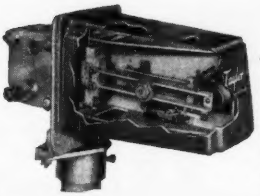
4. Standard angle bracket permits side, top or bottom mounting. Pipe stand mounting (also for side, top or bottom) available.

5. Range change easily and quickly made. Sliding pivot is roughly positioned to within plus or minus 4% of desired range (printed on beam) and locked. Fine trim adjustment by means of screw driver.

6. Relay valve speeds differential pressure changes to controller or receiver, providing excellent linearity and minimum hysteresis.



Flow Transmitter widens selection of Taylor Transmitters!



THIS new Taylor Transmitter is the result of extensive field study and close collaboration with users of force-balance transmitters. It is designed to meet present day industrial requirements for a rugged, dependable and accurate instrument to measure flow, liquid level or specific gravity. With this new development three force-balance transmitters are now available for the measurement and transmission of flow, temperature and pressure.

INEXPENSIVE AND SIMPLE TO INSTALL

• Simplified piping because it can be close coupled to orifice flanges. • No seal pots required—negligible displacement because of force-balance construction. • No leveling—mercuryless dry meter. • Light weight for easy handling; weighs only 23 lbs.

ECONOMICAL, EASY TO MAINTAIN

• Self draining or venting—no periodic manual venting or draining. • Overrange protection to full body rating.

ACCURATE

• Relay valve for linearity, minimum hysteresis, fast speed of response. • Pressure effect 0.2% / 100 psi. change. • Temperature effect 1.0% / 100°F. change.

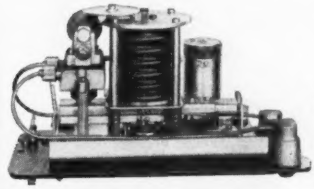
RUGGED AND DEPENDABLE

• Weatherproof housing built for tough service and outdoor mounting. • Force-balance construction; negligible motion; minimum possible wear. • Process sealing bellows 3 ply type 316 stainless steel.

▼ ▼ ▼

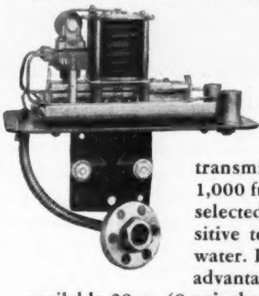
Ask your Taylor Field Engineer for full details of this new Taylor TRANSAIRE Differential Pressure Transmitter, or write for **Bulletin 98226.** Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.



TAYLOR TRANSAIRE TEMPERATURE TRANSMITTER

With Speed-Act. This is a compact, super-responsive instrument designed to measure and transmit smallest temperature changes up to 1000 ft. with great accuracy. It gives you: • Unprecedented speed of response provides dynamic accuracy thanks to derivative action (Speed-Act) in the *measuring* circuit. • It will transmit an output pressure proportional to the measured temperature with an accuracy of plus or minus 0.06 psi.



TAYLOR TRANSAIRE PRESSURE TRANSMITTER

A highly sensitive and accurate suppressed pressure measuring instrument, designed to measure and transmit pressure changes up to 1,000 ft. It is accurate to ½% of the selected short range span and sensitive to pressure changes of ½" water. It gives you these important advantages: • Short range spans available 20 to 40 psi. throughout range limits of 35 to 415 psia, and 50 to 100 psi. throughout 100 to 1,000 psia. • Volumetric type pressure system is extremely accurate, practically clog-proof, has corrosion resistant 316 stainless steel diaphragm. • Temperature and barometric compensation for higher accuracy of measurement and control.

Taylor Instruments

MEAN

ACCURACY FIRST

IN HOME AND INDUSTRY

 Howard C. Gary, McGraw-Hill Dept. of Economics

CAPITAL EXPENDITURES

Millions of Dollars

	Actual 1951	Estimated 1952	Planned 1953	% Change 1952-1953
CHEMICALS	$1,283	$1,503	$1,301	−13
PETROLEUM	2,014	2,812	2,967	+ 5
STEEL	1,304	1,718	1,428	−17
TEXTILES	695	491	417	−15
FOOD	968	933	998	+ 7
MACHINERY	675	773	661	−14
ELECTRICAL MACHINERY	359	407	468	+15
AUTOS	736	909	791	−13
TRANSPORT EQUIPMENT	182	229	144	−37
OTHER MANUFACTURING	2,914	3,033	2,578	−15
ALL MANUFACTURING	11,130	12,808	11,753	− 8

Capital Spending Tapers Off

Chemical companies plan to spend less money—13 percent less—next year for new plants and expansions. But chemical expenditures will still hit $1.3 billion.

Capital spending in chemicals may be down as much as 13 percent in 1953. This estimate comes from a preliminary survey of business plans for new plants and equipment taken by the McGraw-Hill Department of Economics.

The survey reveals the plans which business now has for next year. It provides the first real measure of what 1953 spending will be like. But it is not—in any sense—a forecast.

▶ **Why a Dip?**—There are several reasons why capital outlay in chemicals will dip next year. For one thing, sales and profits figures for many chemical firms have not been too spectacular for the past several quarters.

Perhaps more important, chemical capital expenditures were so great for 1952 that, even with the expected growth in chemical markets, there won't be the need to add new capacity at such a pace.

The chemical figure for 1953 is dragged down by a very severe drop in the spending plans of the rayon companies. The problems that have beset the entire textile field in much of 1951 and 1952 are well known. The cutback in rayon output reflects the textile doldrums.

For companies making industrial chemicals the drop in planned spending averages less than 10 percent.

▶ **Big Picture**—Preliminary analysis indicates that businessmen have tentative plans to spend almost as much on new plants and equipment in 1953 as in 1952. Manufacturing industries will spend about 8 percent less than in 1952. Non-manufacturing industries plan to spend more. So the total capital outlay planned by all business will not be down much.

The really eye-catching news is that manufacturing industries—where the mobilization build-up in capacity has been most impressive, and where sharply lower investment has been forecast by many people—still have impressive plans for new plants and equipment.

These plans add up to less than the enormous total spent by manufacturers in 1952. But they indicate more capital spending than took place in 1951. The prophets of doom who warned of a drying up in capital spending have been proved wrong.

▶ **Little Pictures**—Largest declines are in the transportation equipment industry—reflecting the fact that aircraft makers have most of their defense facilities in place—and in the steel industry, where the new capacity program is also nearing completion. Considerably less spending is also planned by most machinery companies and by the auto industry.

In all these durable goods lines—the so-called defense-supporting industries—1953 plans are close to or higher than actual expenditures in 1951.

The electrical manufacturing industry seems to be an exception to the down-trend among durable goods makers. This industry spent considerably less than it planned in 1952 and expects higher expenditures next year to get on with its program.

Industries making non-durables show diverse trends in their plans for 1953. Oil companies expect to spend more for new wells, refineries and pipelines. This is partly because 1952 spending fell behind schedule. Food processors, on the other hand, exceeded their 1952 spending estimates; yet they are raising their sights again for next year.

Textile manufacturers started cutting back their capital expenditures in 1952 and will spend less again next year. The evident over-capacity of the industry, and a fairly severe squeeze on profits, stand in the way of plans for new equipment.

▶ **Behind the Figures**—Here are some additional sidelights from the recent McGraw-Hill survey:

- There is considerable diversity in plans, even within the same industry. For example, the machinery industry anticipates lower expenditures in 1953. But in some sub-divisions—such as office machinery—spending intentions are up. The food group intends to spend more. But the canners will probably spend less.
- The biggest companies are keeping up their capital expenditures. Smaller companies are cutting down. Total expenditures are held up by

(Continued)

heavy spending on the part of the industry leaders. Much of this appears to be for modernization rather than for expansion.

• Most large companies are going ahead with long-range planning. This survey showed that many manufacturers are now beginning to draw up plans for 1954 and beyond.

• Industry is prepared to make substantial changes in spending plans if manufacturers' sales turn down during the year. Company after company noted, in replying to the survey, that they will make considerable changes in investment plans—and make them fast—if business isn't up to expectations. For companies with long-range programs, this would probably mean stretching out some projects rather than abandoning them.

▶ **Non-Manufacturing** – The preliminary McGraw-Hill survey included primarily manufacturing companies (although some returns came in from a number of larger railroads and mining companies). In order to supplement the survey, McGraw-Hill economists discussed the spending outlook for non-manufacturing industries with a number of experts in those fields.

In general, capital expenditures of these industries are likely to increase in 1953. Private electric utilities and gas utilities are expected to make substantial boosts in spending. Commercial construction—for stores, office buildings or new warehouses—could easily rise by 5 percent over 1952.

Railroads will probably spend less because plans for converting to diesel locomotives, and for adding freight cars, are nearing completion. Present indications are that spending may be off as much as 15 percent. If revenues stay high, however, spending plans may be revised upwards. There's still plenty of modernization to be done.

Mining companies will spend as much in 1953 as in 1952. Coal companies may spend less but this should be more than offset by outlays for some huge metal mining projects that are just getting underway.

▶ **Note of Caution**—The figures in this survey show the general trend of expenditures. But the results must be interpreted with caution because the survey has been made so far in advance of the expenditure period. This information was collected primarily to help

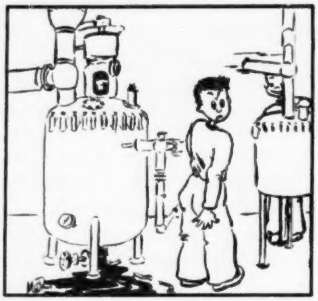
(Continued)

industrial companies—in chemicals and other fields—which have asked for preliminary data as a guide in planning for 1953.

Detailed and more up-to-date figures will be made available early next year. McGraw-Hill will have completed its regular comprehensive survey by that time. And a Department of Commerce study on the post-defense economy will shed additional light on the matter.

But right now we know that business as a whole is going into 1953 with plans for a very high level of capital expenditures. And this greatly improves the chances for continuing general prosperity.

LITTLE BONER



Use Your Own Head First

An experimental run was being made in which methyl cellosolve was used as the solvent. The usual solvent was *n*-butanol.

Since this could lead to an important switch in the plant operations, a detailed materials balance was made. Paul, supervising engineer for the area, made it plain to the operators that he would tolerate no careless slips. To help out (and to keep an eye on things) he pitched in himself.

At one point, a piece of Saran tubing was used to drain the hot solution from a 50-gal. kettle. Paul took care of this operation and did it in the usual way.

He opened the valve on the kettle, saw that it was draining properly, then looked over to see if Charlie was doing things right.

When he looked back he was astounded: His Saran tubing was broken in six places and the kettle was draining on the floor.

Then he remembered—too late—that methyl cellosolve, unlike *n*-butanol, was a potent solvent for Saran.

Paul's face was red for a long time, and the operators still chuckle about his slip. "My mistake," he says, "was to be so damned cocky in the way I told the boys they'd better use *their* heads!"

If you have your own true Little Boner, why not send it in? Address the Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.

MEMO FROM THE EDITOR
Continued from page 141

worked in Bird's centrifugal division as an application engineer for heavy centrifugals and vacuum filters.

That work, which brought him into intimate contact with many segments of the chemical process industries, was extremely broad and diversified. He naturally spent much of his time working on solids-liquid separation problems in processing plants. At the time he left, Cal headed up a staff of eight men in Bird's research and development center. As Cal puts it:

"I feel that those pleasant years with Bird gave me invaluable experience with processing equipment as well as a working knowledge of a great variety of operations in the chemical, pulp and other process industries."

Cal's first job (with Dennison Mfg. Co. in Framingham, Mass.) was in research and development in the pulp and paper field.

At Dennison he picked up experience in new product development from the laboratory scale through full-scale plant production. His technical service work gave him considerable know-how on mechanical equipment used in paper converting.

Cal got his engineering education from Northeastern University, graduating (with honors) in 1940. There he took the School of Engineering's five-year cooperative course in chemical engineering. He paid his way through Northeastern by working as a lab assistant in an offset printing plant during the school year and as a deck hand on a privately-owned schooner yacht during the summers.

It was during those yachting summers that Cal picked up his love for boats and sailing. This explains why he now lives—with his Scotch-descended wife Jean (of the Ferguson clan) and two children—in Old Greenwich, Conn., "within smelling distance of salt water . . ."

▶ **New England Irish**—Cal tells me he was the pride and joy of his old Irish grandfather—all because he happened to be born on July 12. That date, said Grandpa Cronan, was the anniversary of the Battle of the Boyne in 1690 when the Irish fought so gloriously against the English under William, Prince of Orange.*

"Grandpa started a cold war with my parents as soon as he learned that I had been named Calvin—said it

MEMO, *cont. . .*

smacked too much of a Protestant reformer and didn't fit well with Cronan. Yet grandpa was a pillar of the Congregational Church!"

Having spent practically all of his life in Massachusetts, Calvin is steeped in New England folklore as well as the shenanigans of Irish politicians on Boston's Beacon Hill.

Besides, he's proud of his other New England talents: How to make maple sirup, split wood, splice a mooring line, dig clams, find the best berry patches —and say plenty with a couple of words.

And now, I hope, you know a little better that red-headed Irishman from Massachusetts who handles our equipment department and articles. He's worth knowing.

* The Irish (as usual) fought gloriously but (as usual) lost the battle "after charging ten times in succession, although outnumbered two to one." The battle actually took place on July 1 instead of July 12.

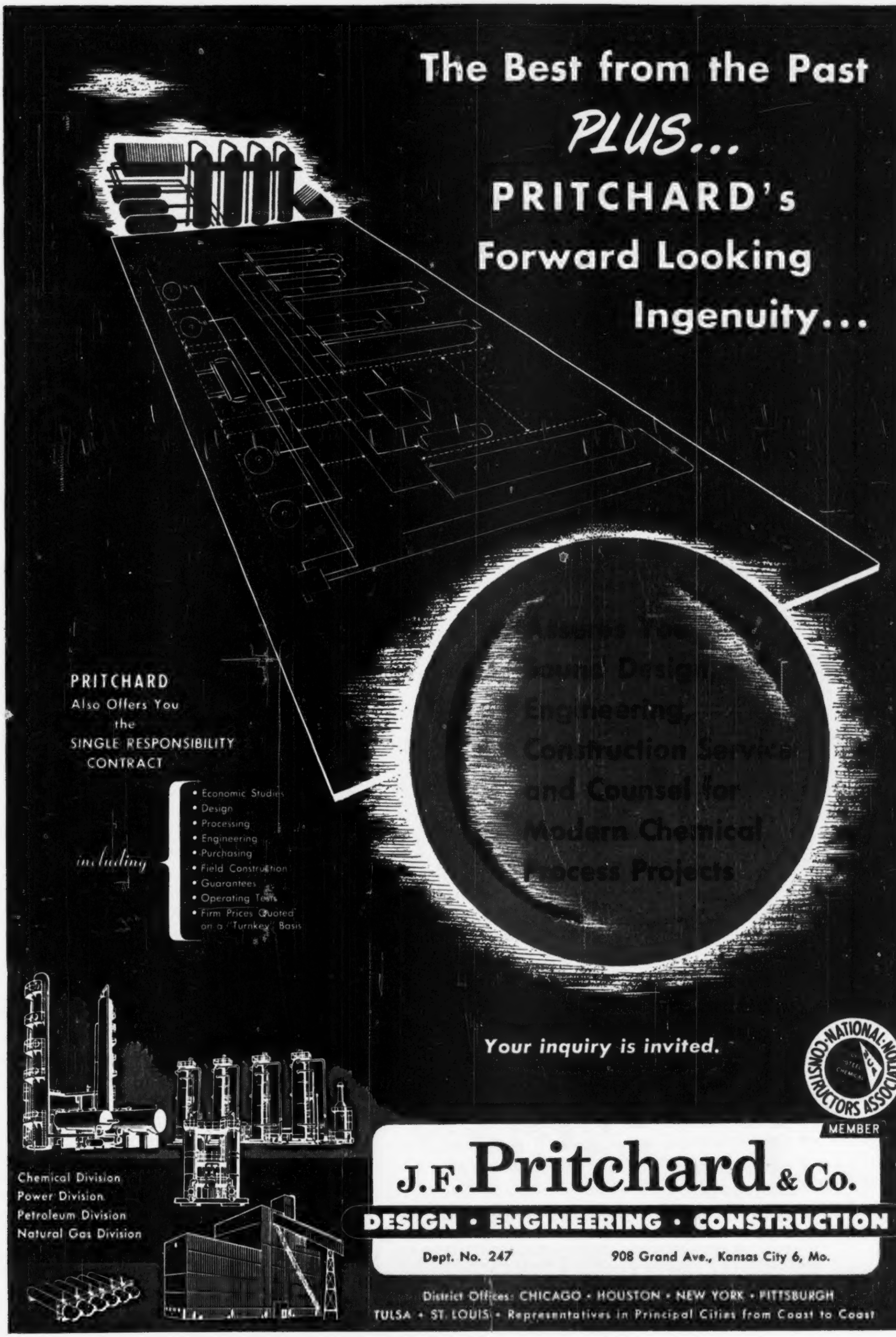
ODOR MEASUREMENT

Continued from page 201

is reached. This makes the nose much more sensitive to the threshold than would be the case if the odorous air were diluted with increasing volumes of fresh air.

The Osmo is made of stainless steel, except for a few brass parts and a Koroseal sampling hose. The valves are adjusted so that the Magnehelic pressure gage (see cut) indicates the same static pressure on both sides of the piston. This is necessary to make sure that the flow of fresh and odorous air is proportional to the number of holes exposed. Under the main cylinder is the activated carbon chamber. Geared to the crank is a counter which shows the position of the piston. This reading is converted to dilutions by using a simple chart. Fans from a commercial, home-type vacuum cleaner were found most suitable for the 10 to 20 cfm flow at 5-10 in. of water suction pressure. The operator inhales at the discharge of the upper fan. The chamber on top of the cylinder, containing ten needle valves, was incorporated to increase the accuracy of measurements at high concentrations, where a slight movement of the crank normally changes the dilution ratio by a sizeable amount.

The reproducibility of readings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Odor Measurement, cont. . .

with this instrument from day to day has varied somewhat with the operator and his physical condition. The average deviation from average varies from a few percent to 30 or 40 percent, but measurements made within an hour or two are much more consistent. Therefore, the unit has been most satisfactory for measuring the odor of an exhaust before and after a given treatment to indicate the efficiency of odor removal.

The Osmo, and the quantitative approach to odor studies, have proven very valuable in odor control work. Some applications in which they have been used are as follows:

1. Measurement of the odor concentrations of an odor furnace exhaust showed optimum odor removal at an exhaust temperature much lower than was believed possible. This has resulted in fuel savings of $50,000 per year.
2. Odor survey of a factory, and determination of the odor discharge rate of significant odor sources, in odor units per minute. This permits identification of the larger odor sources and concentration on them to reduce total factory odor emission.
3. Determination of stack heights, using stack diffusion formulas, which will give maximum ground odor concentration equal to 1, and hence dilute odorous discharges below the odor threshold.

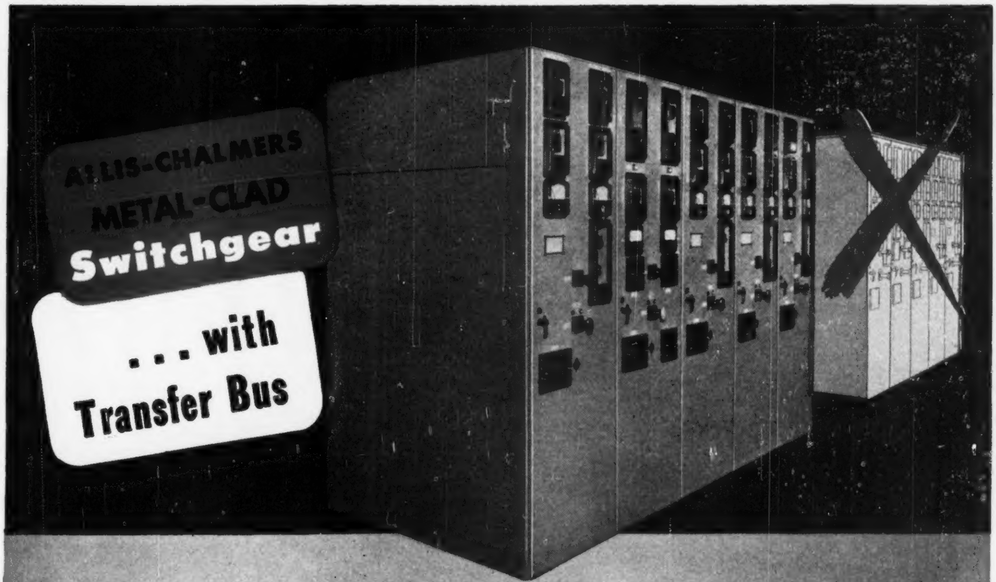
Two of the Osmo units are now in use by Procter & Gamble. Some improvements, such as a funnel and face-piece to guide air to the observer's nose, and an electric heater to reduce condensation problems, are being tried. Other problems remain, but the Osmo is believed to be a definite step forward in odor measurement, especially for the evaluation of industrial process discharges.

ACKNOWLEDGEMENT

Special credit is due Messrs. R. L. Kramer, E. L. Dewey and D. R. Shern of the Engineering Division of Procter & Gamble. These men were almost wholly responsible for the development of the "Osmo."

REFERENCE

[1] McCord, C. P. and W. N. Witheridge, "Odors, Physiology and Control". 1st ed., 1949, McGraw-Hill Book Company, Inc., New York.



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YOU PAY ONLY for the addition of the transfer bus . . . not a complete set of duplicate switchgear.

WHAT IS A TRANSFER BUS?

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ALLIS-CHALMERS supplies transfer bus right in the same cubicle as switchgear, without adding cubicles . . . thus cutting floor space requirements in half.

TAKE A TIP FROM UTILITIES! Their experience in many installations proves that you, too, can eliminate duplication of switchgear in many places . . . yet assure power continuity.

Ask an Allis-Chalmers engineer about transfer bus arrangements and what they can mean to your plant in savings and service. Call your nearby Allis-Chalmers district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

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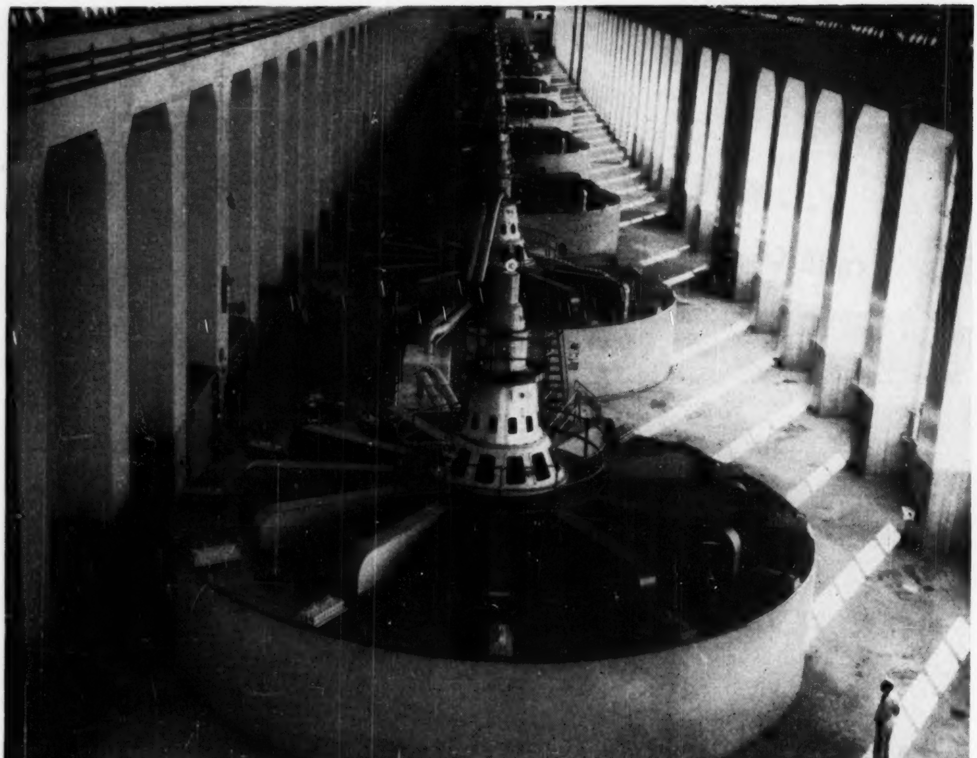
A Regional Survey



GENERATORS such as these giants at Bonneville—and others a-building—underscore why . . .

Power Is the Key to More Northwest Industry

Today, a power pinch. Tomorrow, more industry hinged on 3-mill power. That's the Pacific Northwest picture—an undeveloped potential of 10 million kw.

ELLIOT SCHRIER

In mid-November major Pacific Northwest industries were asked by Defense Electric Power Administration to curtail their firm kilowatt loads by ten percent—the first time such a cut has been ordered for the area. Interruptible loads had already been cut back in early September.

Yet one fact overshadows this severe seasonal power pinch: The Pacific Northwest is still the country's only area that can boast of an undeveloped potential of 30 million kw.

What's more, Bonneville Power Administration estimates that some 10 million kw. of this potential can be developed at 3 mills per kwh.

That's why far-sighted industrialists throughout the U. S. still look to the Pacific Northwest as the source of their future requirements for cheap electric energy. Further industrialization will certainly come from the generating capacity already authorized or now being built.

▶ **Today's Picture**—The November cut-back in firm loads was actually to conserve reservoir levels, since the flow of the Columbia is already below the 1936-1937 levels and is still dropping. This year's Columbia Basin

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ELLIOT SCHRIER, *our Western Editor in San Francisco, prepared this story after checking with process industry leaders in the Northwest as well as representatives from private municipal and federal power organizations. Figures were supplied by Bonneville Power Administration.*

drought has been the worst in 30 years.

The cut in firm contracts, which comes off the 1951 power-use base, will save an estimated 110,000 kw. Close to 1,000 plants using more than 8,000 kw. weekly are affected. Some 65,000 kw. will come off aluminum reduction plant loads—thus trimming the area's output of aluminum by 2,500 tons a month. About a dozen additional electro-process industries served directly by BPA will feel the pinch.

Generation of electricity from natural water flow in the western half of the Northwest Power Pool dropped more than a million kilowatts during September alone because of a continuing fall in stream levels. This amounts to half of the present water-flow output.

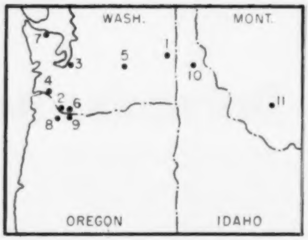
During the same period, the natural water generating capacity of the federal system (Bonneville and Grand Coulee) fell from 2,600,000 kw. to 1,600,000 kw.; non-federal natural flow capacity dropped from 438,000 kw. to 378,000 kw. This decline exceeds any seasonal low water period since Bonneville Dam was built.

► **Cut in Interruptible**—For the second consecutive year Bonneville Power Administration has also had to cut interruptible power to its industrial customers. These are mainly aluminum plants; magnesium, chlorine, ferroalloy, manganese and others are also affected.

Last year's power deficiency was 600,000 kw., about evenly divided between firm and interruptible, and the cut-off lasted 13 days. This year the switch was pulled on September 4.

The overall shortage is still about 600,000 kw. But this year's firm loads are short only 150,000 kw. New facilities brought in during the past year added roughly 500,000 kw. to usable supplies, while firm power loads increased only 350,000 kw. On the other hand, steam generating capacity is already committed to firm loads; last year it supplemented interruptible loads.

By next year firm power demands and firm power capacity under minimum-year hydroelectric conditions should be just about in balance. After that, up-stream storage capacity will increase steadily, permitting reservoirs to be drawn down more and more to protect interruptible loads.



Where Current Low-Water Period Has Cut Interruptible Power

1. **Spokane, Wash.**
   Kaiser .... Aluminum
   Chromium Min. & Smelt. . Magnesium
2. **Vancouver, Wash.**
   Alcoa .... Aluminum
   Carborundum .... Abrasives
3. **Tacoma, Wash.**
   Kaiser .... Aluminum
4. **Longview, Wash.**
   Reynolds .... Aluminum
5. **Wenatchee, Wash.**
   Alcoa .... Aluminum
   Keokuk Electro-Metals . . Ferro-alloys
6. **Camas, Wash.**
   Crown Zellerbach .... Paper
7. **Port Angeles, Wash.**
   Crown Zellerbach ...... Pulp & paper
   Rayonier .... Pulp & paper
8. **Portland, Ore.**
   Electro-Metallurgical .... Calcium carbide & ferro-alloys
   Pacific Carbide ...... Calcium carbide
   Penn Salt Mfg. .... Chlorates insecticides, chlorine & caustic
9. **Troutdale, Ore.**
   Reynolds .... Aluminum
10. **Kellogg, Idaho**
    Sullivan Mining .... Zinc
11. **Silver Bow, Mont.**
    Victor Chemical .... Phosphorus

► **No Cause for Alarm**—Last year's suggestion that Pacific Northwest aluminum plants be moved to another part of the country gave the impression that there is no power available in the Northwest for industrial expansion. Predictions of a general brown-out that never materialized added weight to that conclusion. As a result, at least one large company decided to build in the Ohio Valley instead of in the Northwest.

Yet Northwest industrialists familiar with the overall picture feel that the company's decision was based on a misconception.

Partisans of both public and private power agree there is enough generating capacity a-building and authorized to support increased industrialization—and enough low-cost hydroelectric potential for continuous expansion for a number of years. Disagreement centers only on how power should be marketed and whether increased capacity should be allocated to a few large industries or to a number of small plants.

How rapidly industry will expand in the Northwest, however, depends on how far and how fast hydroelectric development of the Columbia River system is pushed. In 1951 this area (stretching from the Pacific Coast to

the Continental Divide and from the Canadian border to California, Nevada, and Utah) obtained about 97 percent of its electrical energy from the river system; for the U. S. as a whole, hydro contributed only about 27 percent of the nation's electric energy.

▶ **Potential Is Big**—Federal Power Commission estimates there is an undeveloped potential of over 30 million kw. in the Pacific Northwest. Some 10 million of this, FPC says, can be developed to sell at less than 3 mills per kwh. (The current rate is 2 mills per kwh. at a 100 percent load factor, but rates will be raised as more expensive projects are averaged in with Bonneville and Grand Coulee.)

In 1942 Northwest public and private interests sat down together to discuss development of the area's hydroelectric resources, formed the Northwest Power Pool. At that time the Pool had about 2,700,000 kw. of peaking capacity at its disposal; of this 2 million kw. was available to the Western Group (public and private utilities operating in the power-short area of Washington, most of Oregon, northern Idaho and part of western Montana).

Allowing for minimum-year hydroelectric conditions, by 1958-59 plants now under construction will bring the total firm power available to the Western Group to 4,918,000 kw.—just about double the area's current supply. Federal plants will add 2,083,000 kw., non-federal 339,000 kw. An additional 500,000 kw. will be available under average water conditions. About 330,000 kw. of existing steam-generating capacity will also be available.

▶ **Picture by 1959**—Last year the Northwest turned out about 30 billion kwh. from its hydro resources, 456 million kwh. by steam generation. Counting on median water years and maintenance of present and proposed construction schedules, additional amounts of power will become available for industrial expansion as follows:

Year	Average Kw.
1954-55	156,000
1955-56	275,000
1956-57	363,000
1957-58	512,000
1958-59	1,055,000

These amounts (over and above the requirements of existing firm and interruptible loads) include (1) estimated increases in demand by present users other than electro-process indus-

tries, (2) 500,000 kw. of firm power set aside for private utilities as it becomes available (under terms of a BPA-private utilities contract signed in 1951) and (3) 120,000 kw. of firm power allocated to new defense industries (10,000 for abrasives at Vancouver, Wash., 65,000 for nickel at Roseburg, Ore., 40,000 for an unnamed potential new aluminum producer and 5,000 kw. for chemicals).

Until 1956-57 this power will be available only on an interruptible basis and will include some steam; after that date it will be part interruptible and part firm. In the past, estimates of future Northwest power demands have been consistently low; this might well apply to Bonneville's estimates for 1954-1959.

Bonneville Power estimates that over the years interruptible power is available about 75 percent of the time. During the past four years, loss of interruptible power has cost the Northwest aluminum industry only 6 percent of its designed production capacity; the loss has varied between 25 percent in 1948-49 and nothing in 1950-51.

In that period the industry produced 232,000 tons of aluminum using interruptible power, lost only 16,000 tons. At the same time it produced 1,132,000 tons using firm power.

Last year Northwest interruptible power was responsible for 10 percent of the aluminum produced in the nation. Some 2,000 tons was lost during the power shortage, but over 3,500 tons was lost during a strike at Reynold's Troutdale, Ore., plant.

For the two year period ending June 30, 1952, power costs for the aluminum industry averaged $45 per ton, including firm, interruptible and steam-generated. This compares favorably with power costs as high as $78-80 per ton in some other areas of the country.

▶ **What Two Firms Did**—How willing Northwest industry is to gamble on interruptible power supplies was illustrated by the decisions of Pacific Carbide and Alcoa.

When it became obvious last year that interruptible loads would have to be cut to maintain the reservoirs and protect firm power supplies, Pacific Carbide asked to remain on stream during the cut-off. This was based on the condition that if rainfall was not

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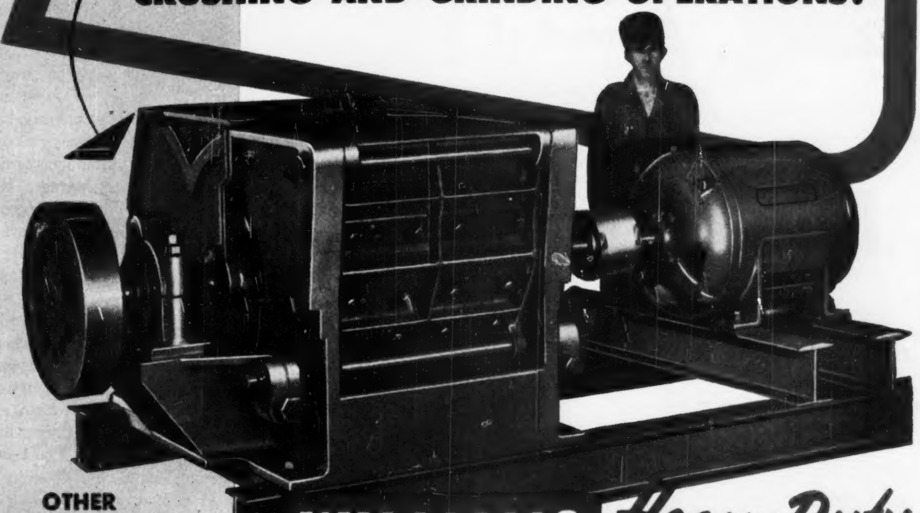

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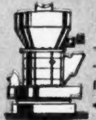

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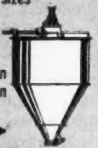

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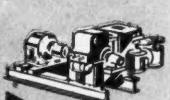

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sufficient to fill the reservoirs later on it would forfeit an equivalent number of kwh.'s out of its firm power block plus an additional amount to cover loss of head caused by the September draw-down. BPA accepted the proposal.

While other plants switched to steam-generated power or shut down, Pacific Carbide stayed on hydro. The rains came, the reservoirs filled up and Pacific Carbide paid only its usual rate for the interruptible power it consumed during the shortage. Had the rains not come, however, the company would have had to halt part of its operations based on firm power as well as all of those based on interruptible power.

This year Alcoa did much the same thing. Additions to Rock Island dam were scheduled to turn the first generator for Alcoa's new aluminum plant at Wenatchee, Wash., on September 15. The current shortage, however, would have forced BPA to cut power, causing Alcoa to close down its potline for 11 days—an expensive proposition. Alcoa asked BPA to keep its potline on-stream until it gets 40,000 kw. from Rock Island, Alcoa to pay in kind as additional Rock Island generators go on stream.

Bonneville engineers calculated that loss of head on the reservoirs would cost BPA about 0.25 kwh. for every kwh. sold to Alcoa during the period. Thus Alcoa gambled on having to pay about 1.25 kwh. for every kwh. it used. Even if Alcoa only had to pay back kwh.-for-kwh. it still won't be able to start up its second potline as soon as it had planned. But since it didn't have to close down its first potline at all, Alcoa officials believe they're ahead of the game.

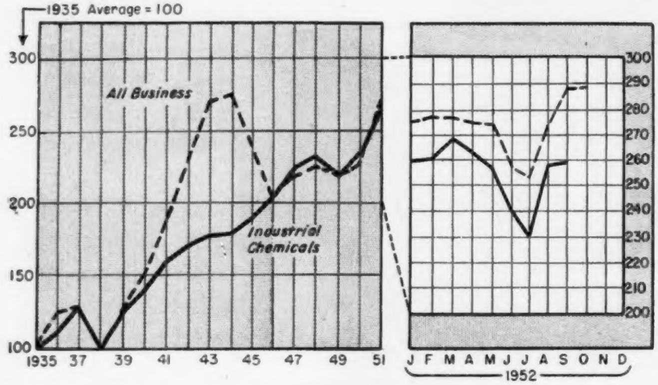
►**Nowhere Else**—Recurrence of the Northwest power shortage depends on several factors: (1) the weather cycle, (2) whether Congress and private utilities will maintain and expand present new generating schedules and (3) how fast industry expands into the Northwest.

And expand it will, for nowhere else in the nation is there a potential of 10 million kw. at 2.5-3 mills per kwh. You may hear more about the Pacific Northwest power shortage and "lost" production, but in the long run you'll hear more about industrial expansion into the area.

—End

Process Industry Trends

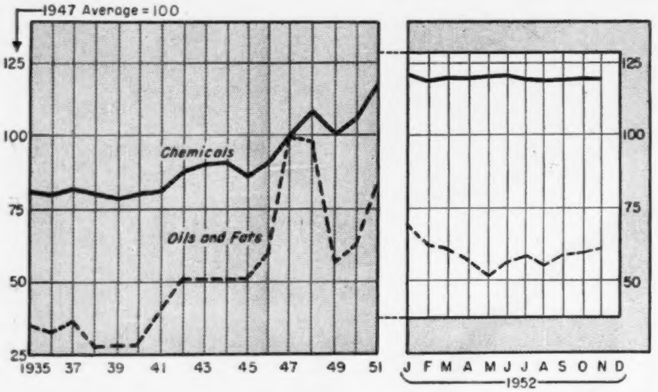
CONSUMPTION



Industrial Chemicals Index

	Sept. (Est.)	Aug. (Prelim.)	July (Revised)
INDEX	265.00	264.89	230.12
Fertilizer		57.42	55.33
Pulp and paper	26.93	27.83	24.67
Petroleum refining	26.20	27.34	28.06
Iron and Steel	17.13	15.59	2.98
Rayon	30.56	30.50	28.20
Glass		23.37	22.84
Paint and varnish		27.01	27.00
Textiles		11.17	8.79
Coal products	11.07	11.20	3.53
Leather		3.82	3.58
Explosives		9.02	7.40
Rubber	6.12	5.37	5.16
Plastics		15.25	12.58

PRICES

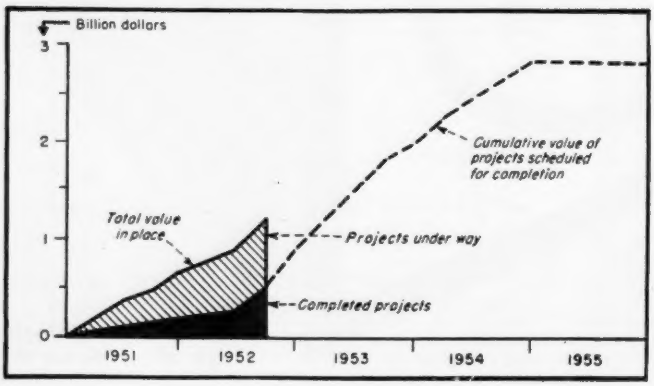


Chemical Engineering's Price Indexes

Chemicals DOWN -0.02%
Oils and Fats: UP +2.0 %

	Chemicals	Oils & Fats
As of November 1, 1952	119.06	60.98
Last month	119.08	59.81
November, 1951	119.92	74.24
November, 1950	114.68	78.73

HIGHLIGHT OF THE MONTH



New Facilities Are Inching

Chemical industry expansion, aided by certificates of necessity, has been inching ahead—slowly. Many projects have been pushed back so completion will not occur before 1955.

The total of new facilities proposed for the industry currently runs just under $3 billion. However, the value of work now in place accounts for much less than 50 percent of the total proposed investment for the industry. But rates of progress vary: pharmaceuticals are almost 100 percent completed, industrial inorganics are less than a third finished.

New Construction

Proposed Work

Ia., Des Moines—Armstrong Rubber Manufacturing Co., Frederick Machlin, Pres., West Haven, Conn., plans to construct an addition to its plant here. Estimated cost $2,500,000

La., Terrebonne Parish (Houma P. O.)—Cities Service Oil Co., 1800 Airline Hy., New Orleans, La., plans to construct a natural gas plant and facilities. Estimated cost $2,840,000

Mo., Joplin—Missouri Farmers Assn., Columbia, plans to construct a fertilizer plant. Estimated cost $3,500,000

N. Y., Syracuse—Solvay Process Div. of Allied Chemical & Dye Corp., 61 Broadway, New York, N. Y., plans to construct new soda ash facilities here. Estimated cost $10,000,000

Tex., El Paso—Catalytic Cracker Plant, El Paso, plans to construct a solvents production plant, also a 9,000 bbl. daily capacity crude oil products plant. Estimated cost $15,000,000

Tex., Midland—Pure Transportation Co., Midland, plans to construct a petroleum storage plant. Estimated cost $243,500

Tex., Sweetwater Lone Star Cement Corp., First Natl. Bank Bldg., Dallas, plans to double the capacity of its plant at Maryneal, near here, to produce approximately 1,125,000 bbls. cement annually. Estimated cost $13,000,000

Wash., Tacoma—Stauffer Chemical Co., Tideflats, plans to construct an addition to its chemical plant. Estimated cost $320,000

Alta., Edmonton—Barcam Co., Ltd., 1718 West 5th Ave., Vancouver, B. C., plans to construct a gas absorption plant. Estimated cost $10,000,000

Ont., Toronto—Rohm & Haas Co. of Canada, Ltd., Terminal Bldg., Toronto, plans to construct a chemical plant in the Scarbor industrial area. Estimated cost $3,000,000

Contracts Awarded

Ariz., Florence—Proven Oil & Refining Co., L. M. Glasco, Pres., 311 S. Akard St., Dallas, Tex., has awarded the contract for the construction of an oil refinery to Ebasco Services, Inc., 2 Rector St., New York, N. Y. Estimated cost $18,000,000

Ark., Gum Springs—Reynolds Metals Co., 3rd and Grace Sts., Richmond, Va., has awarded the contract for the Robert B. Patterson aluminum reduction plant to Ditmars-Dickman-Pickens Construction Co., 115 West 7th St., Little Rock, and W. S. Bellows Construction Co., 716 North Everton St., Houston, Tex. Estimated cost $30,000,000

Calif., Avon—Monsanto Chemical Co., 1700 S 2nd St., St. Louis 4, Mo., has awarded the contract for the construction of a plant for the production of phenol on an 86 acre site here to United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Pa.

Ga., Atlanta—Sinclair Refining Co., P. O. Box 1770, will construct an oil loading platform here. Work will be done by owners. Estimated cost $100,000

	Current Projects: Proposed Work	Current Projects: Contracts	Cumulative 1952: Proposed Work	Cumulative 1952: Contracts
New England	....	....	$7,600,000	$5,379,000
Middle Atlantic	$10,000,000	$250,000	54,100,000	57,398,000
South	2,840,000	6,690,000	383,405,000	263,486,000
Middle West	....	5,000,000	64,430,000	149,460,000
West of Mississippi	34,563,000	71,551,000	651,846,000	568,712,000
Far West	....	23,000,000	131,915,000	118,153,000
Canada	13,000,000	4,000,000	175,833,000	52,689,000
Total	$60,403,000	$110,491,000	$1,469,129,000	$1,215,277,000

Ga., Savannah—Southern Paperboard Corp., c/o J. E. Sirrine & Co., Engr., Greenville, S. C., has awarded the contract for plant additions to Daniel Construction Co., P. O. Box 2286, Greenville, S. C. Estimated cost $750,000

Kan., Galena—Eagle Picher Co., American Bldg., Cincinnati, O., has awarded the contract for sulphuric acid plant to Leonard Construction Co., 37 S. Wabash St., Chicago, Ill. Estimated cost $4,000,000

Ky., Louisville—Cochran Foil Co., 1430 S. 13th St., has awarded the contract for the design and construction of a factory to The Austin Co., 16112 Euclid Ave., Cleveland. Estimated cost $200,000

Md., Baltimore—Buck Glass Co., Fort Ave. and Lawrence Sts., has awarded the contract for a 1 story, 101x102 ft., 260,000 cu. ft. storage building to Maryland Metal Building Co., Inc., Race and McComas Sts.

Miss., Greenwood—Quinn Drug & Chemical Co., Highway 49, will construct a plant addition with own forces. Estimated cost $150,000

Miss., Gulfport—Gulfport Glass Corp., c/o George Hopkins, contractor, 19th St., will construct a plant. Estimated cost will exceed $200,000

Miss., Yazoo City—Mississippi Chemical Corp., Yazoo City, has awarded the contract for a plant addition to Girdler Corp., 224 E. Broadway, Louisville, Ky. Estimated cost $5,000,000

Neb., LaPlatte—Allied Chemical & Dye Corp. (Nitrogen Div.), 40 Rector St., New York, N. Y., has awarded the general contract for a plant to produce ammonia and urea fertilizers to Catalytic Construction Co., 1528 Walnut St., Philadelphia, Pa.; for design and erection of gas reforming and purification equipment to Girdler Corp., 224 E. Broadway, Louisville, Ky. Estimated cost $25,000,000

N. C., Williamston—Standard Fertilizer Co., Williamston, will construct an addition to its plant with own forces. Estimated cost $200,000

O., South Point—Allied Chemical & Dye Corp. (Nitrogen Div.), 40 Rector St., New York, N. Y., has awarded the contract for design and construction of a fertilizer plant to John J. Harte Co., 284 Techwood Dr., N. W., Atlanta, Ga. Estimated cost $5,000,000

Tenn., Chattanooga—Cutter Laboratories, Inc., c/o J. W. B. Lindsey, contractor, 401 N. Market St., will construct a warehouse. Estimated cost $90,000

Tex., Angleton—Southern Production Co., W. T. Waggoner Bldg., Fort Worth, and Humble Oil & Refining Co., Humble Bldg., Houston, has awarded the contract for a high pressure absorption type gasoline refining plant to Stearns-Roger Manufacturing Co., 1720 California St., Denver, Colo. Estimated cost $4,775,000

Tex., Baytown—Consolidated Chemical Industries, Inc., 111 Sutter St., San Francisco, Calif., and Humble Oil & Refining Co., Baytown, will construct a sulphuric acid manufacturing plant. Work will be done with own forces. Estimated cost $4,750,000

Tex., Byers—Lone Star Gas Co., 1915 Wood St., Dallas, will construct a dehydration unit. Work will be done by purchase and hire. Estimated cost $250,000

Tex., Cleburne—Lone Star Gas Co., 1915 Wood St., Dallas, will reconstruct its warehouse. Work will be done by day labor and sub contracts. Estimated cost $135,000

Tex., Conroe—Columbia Carbon Co., Conroe, will enlarge its carbon black plant here. Work will be done by purchase and hire. Estimated cost $475,000

Tex., Hawkins—Natural Gasoline Corp., Hawkins, has awarded the contract for expanding its gas plant to Gasoline Construction Co., N. Esperson Bldg., Houston. Estimated cost $875,000

Tex., Leaguesville—Gulf Oil Co., Kilgore, will construct a booster station. Work will be done by purchase and hire. Estimated cost $125,000

Tex., Petrolia—Lone Star Gas Co., 1915 Wood St., Dallas, will construct a dehydration plant unit with own forces. Estimated cost $190,000

Tex., Port Arthur—Gulf Oil Corp., Port Arthur, will improve and enlarge its refinery. Work will be done by purchase and hire. Estimated cost $507,500

Tex., Stinnett—Phillips Petroleum Co., Borger, will construct a petroleum storage plant. Work will be done by day labor and subcontracts. Estimated cost $214,000

Tex., Seminole—Phillips Chemical Co., Seminole, will construct a sulphur extraction plant unit. Work will be done by day labor and subcontracts. Estimated cost $255,000

Ont., Clarkson—British-American Oil Co. Ltd., Bay and College Sts., Toronto, has awarded the contract for process units for oil refinery expansion, including catalytic cracking unit, polymerization and gas concentration units, to Canadian Kellogg Co., Ltd., 194 Bloor St., W., Toronto. Estimated cost $4,000,000

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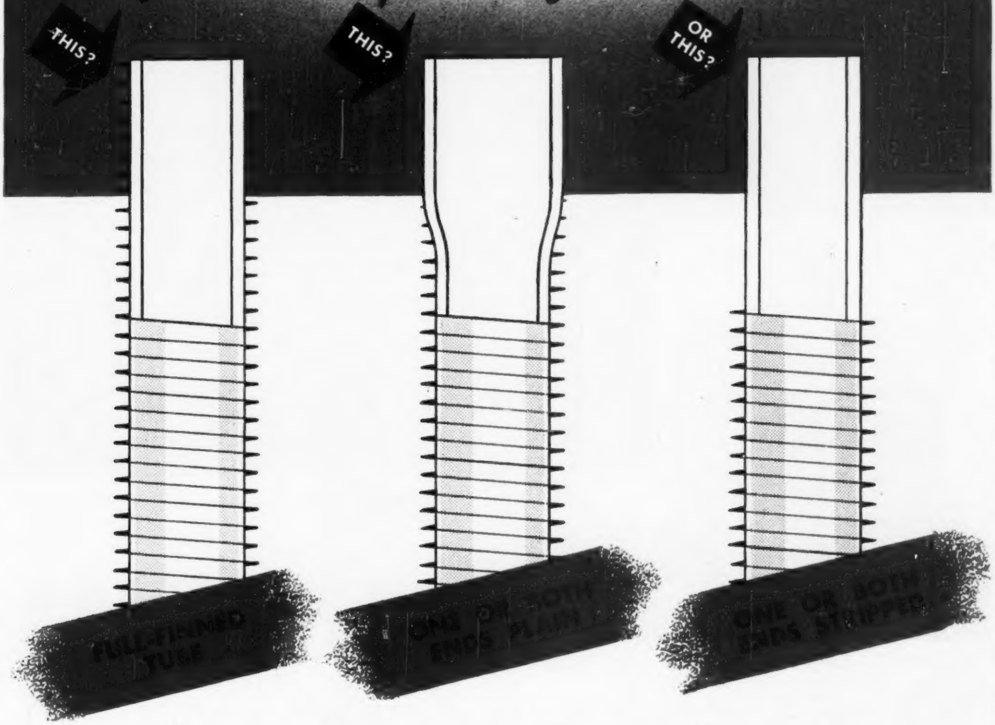

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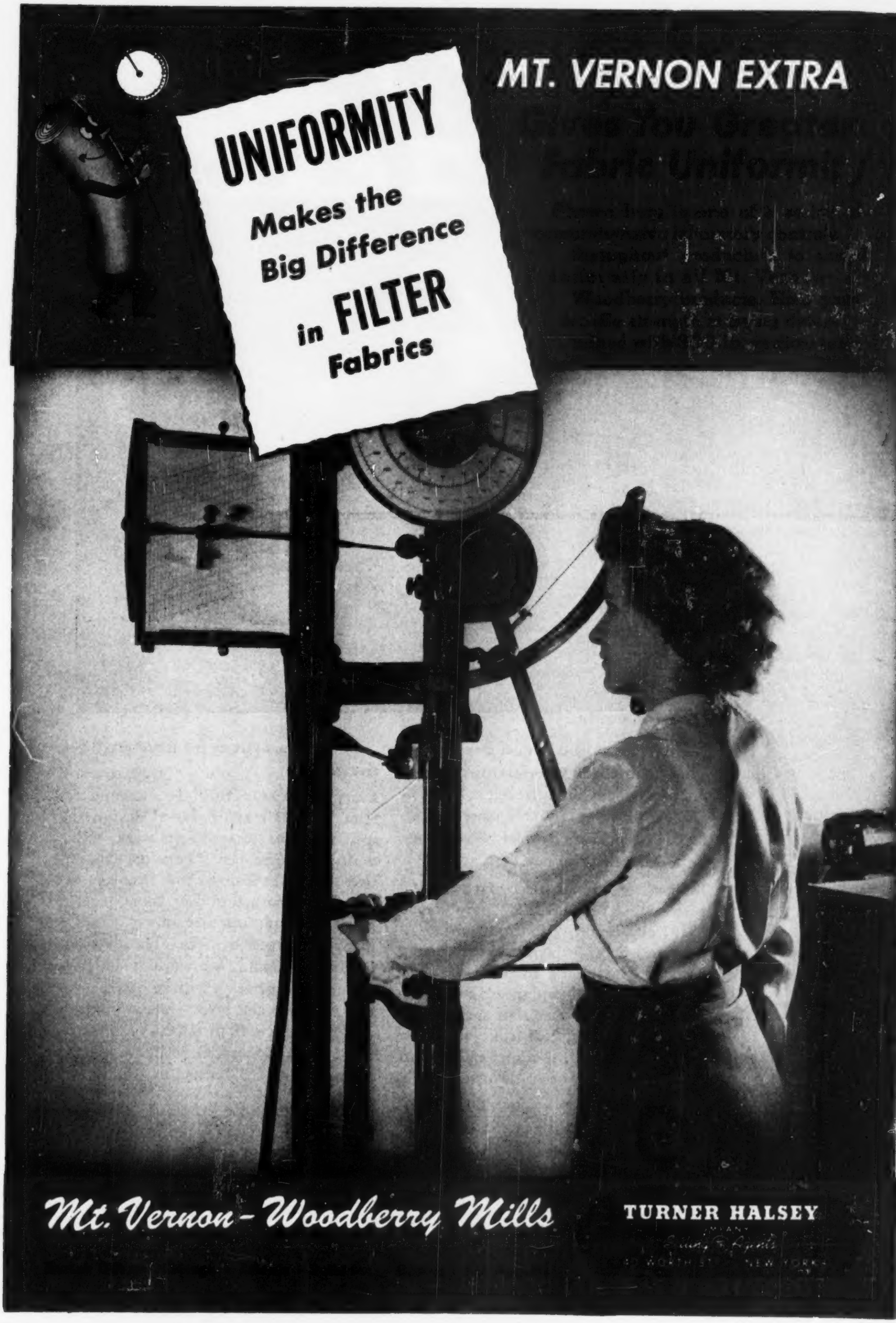

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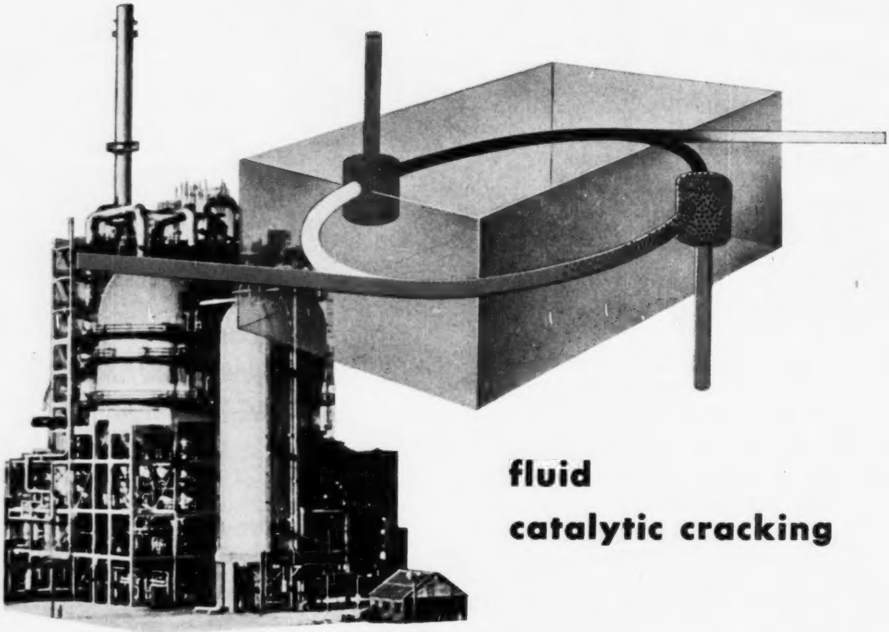

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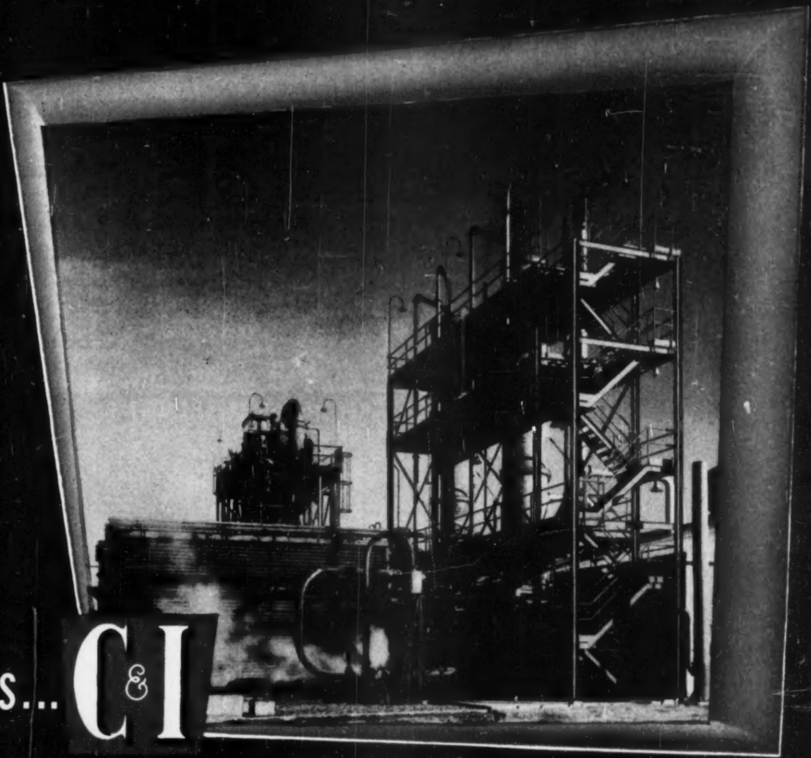

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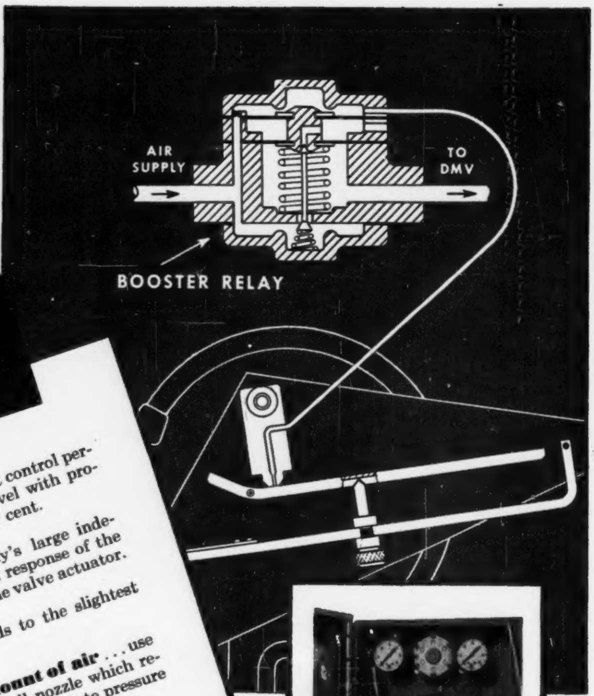
It's the BOOSTER RELAY that gives this Pressure Controller these 4 exclusive features

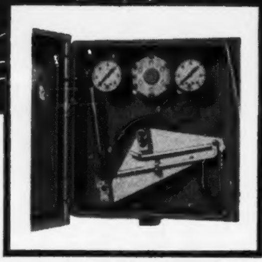


1 It's accurate . . . provides closest control performance, including full valve travel with proportional band set as low as 1 per cent.

2 It's fast . . . the booster relay's large independent air supply permits fast response of the valve, regardless of the size of the valve actuator.

3 It's sensitive . . . responds to the slightest pressure changes.

4 It uses a minimum amount of air . . . use of booster relay permits small nozzle which requires only 0.1 scfm under steady state pressure conditions.



Internal view at top shows arrangement of elements depicted in diagram. External view at bottom shows Pressure Pilot with door closed.

New Honeywell Pressure Pilot

In ruggedness, too, the Pressure Pilot leads the way. It goes anywhere . . . takes the toughest field conditions in stride. It makes a fitting companion, of course, for Honeywell's Series 700 valve line.

It has every other feature you need: easy adjustment of set point, positive overload protection, simple construction, quick reversibility, universal mounting; and best of all, the cost is surprisingly low.

Our nearest engineering representative will be glad to demonstrate the Pressure Pilot for you right in your plant. Call him today . . . he is as near as your phone.

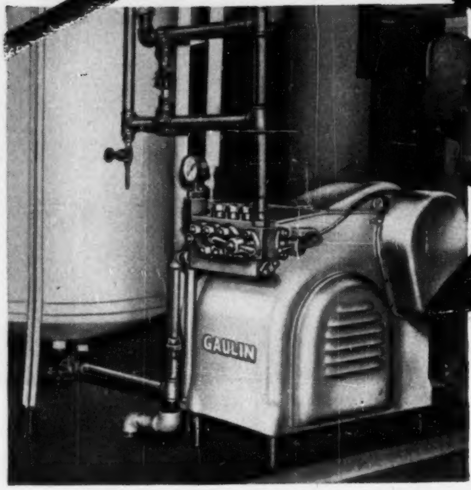
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 1904 Windrim Ave., Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
VALVE PRODUCTS
First in Controls

● *Important Reference Data*

Write for new Bulletin 16-1, "Honeywell Pressure Pilot."

It's Uniformly Finer here



BRISTOL MEYERS installation at Hillside, N. J. showing 500 GPH Gaulin Homogenizer used in processing Vitalis Hair Cream.

because it's emulsified here

...with a **Gaulin Homogenizer**

Cream oils look less greasy, feel less greasy . . . spread quicker, hold better when they're made with a Gaulin Homogenizer.

But most important, they WON'T SEPARATE EVER, because Gaulins break fluid particles smaller . . . disperse them evenly to make a *uniformly finer* emulsion or dispersion.

What's more, experience proves Gaulins emulsify them FASTER, MORE ECONOMICALLY, too.

Why not investigate for your product, today. Complete testing facilities and recommendations are yours — without obligation.

GAULIN PILOT PLANT HOMOGENIZER

Ideal for experimental purposes, operation or process requiring up to 25 gallons per hour capacity. Handles quantities as small as one pint. Available on low rental basis.

GAULIN TWO-STAGE COLLOID MILL

Stator is jacketed for cooling or heating. Gap setting adjustable for .001" to .045". Only 45 seconds clean-up required in changing colors. 12" head room. 12" x 17" floor area.

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MANUFACTURING COMPANY, INC.

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World's largest manufacturer of Homogenizers, Triplex Stainless-Steel High Pressure Pumps, and Colloid Mills

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Of course, Allis-Chalmers Certified Service Shops give good service on any electrical equipment, of any make. Tear out this ad and save it, or write the name of the A-C Certified Service Shop nearest you in your address book. Allis-Chalmers, Milwaukee 1, Wisconsin. A-3864

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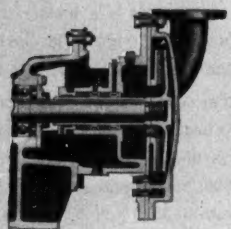
CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

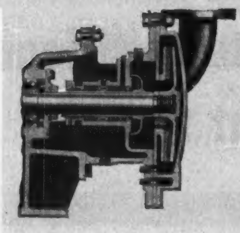
PUMPS — Integral types from ¾ in. to 72 in. discharge and up.

ALLIS-CHALMERS
PROCESS PUMPS

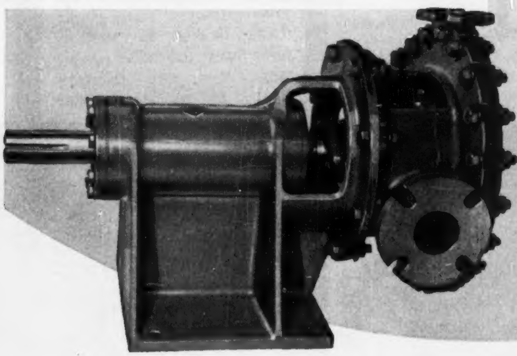


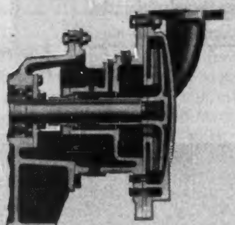
Standard Stuffing Box — for suction lift. Stuffing box on the suction side limits pressure on packing to suction pressure. Under suction lift conditions, the liquid being pumped does not enter the stuffing box.

VERSATILITY that Cuts Your Pumping Costs



***Equiseal* Stuffing Box — for suction heads to 15 feet.** The *Equiseal* stuffing box is equipped with an auxiliary impeller which produces a low pressure area in front of the packing. This low pressure area prevents the liquid being pumped from entering the packing on suction heads up to 15 feet at 1750 rpm.





Mechanical Seal — for suction heads over 15 feet. The Allis-Chalmers Process Pump may be fitted with a variety of mechanical seals for conditions where the suction head exceeds 15 feet. Each application is individually engineered.

YOU CAN HANDLE A WIDE RANGE of products with one type of pump when it is an Allis-Chalmers Type P Process Pump. Each of the three sealing methods shown here is interchangeable on any Type P pump with a minimum of alteration to the pump itself. No new major parts or permanent alterations are required to use any of these sealing methods.

CHOICE OF MATERIALS

The Allis-Chalmers Process Pump is available in a wide choice of materials to handle many combinations of abrasiveness and corrosiveness in the liquid to be pumped. Usual materials include aluminum bronze, *Ni-Resist*, 316 stainless steel, and 18% chrome steel, plus almost any special material which may be required, including non-machinable alloys. Parts subject to varying rates of wear are separated for easy replacement.

GET DETAILS

For complete details on the Allis-Chalmers Process Pump plus competent engineering assistance, call your nearby Allis-Chalmers District Office. Or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletin 52B6615.

A-3902

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ALLIS-CHALMERS

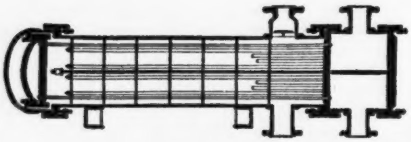
in chemical installations it's ALCO for greater efficiency in heat transfer

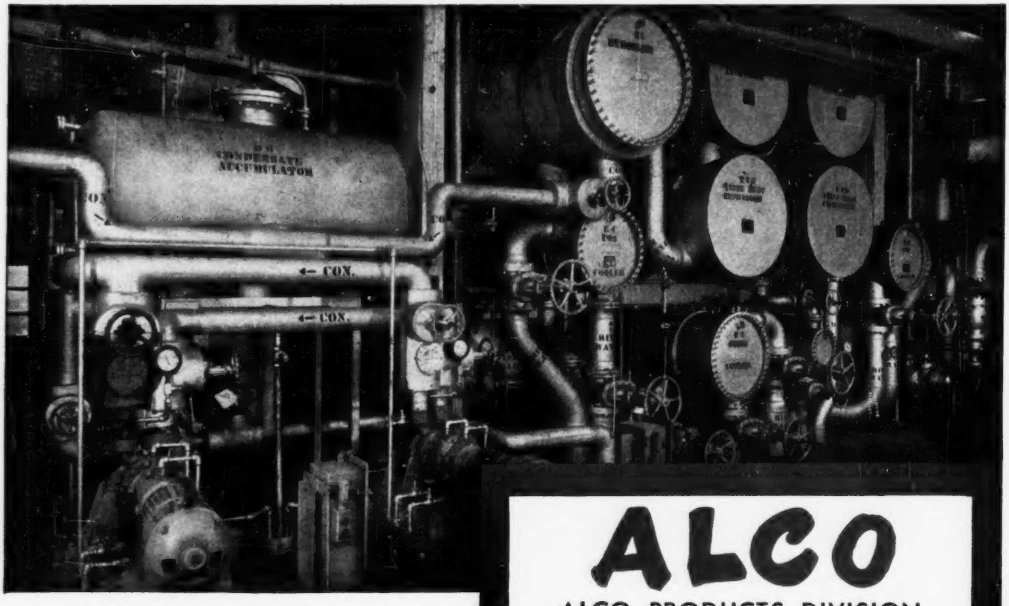
The effectiveness and versatility of ALCO heat exchangers is a matter of record—that's why ALCO enjoys leadership in production in the heat exchanger field.

Custom engineered to *your* specifications, ALCO heat exchangers range up to twelve feet in diameter; in weight, from 100 to 300,000 pounds; in pressure, from high vacuum to 3000 psi; in temperature, from minus 300 F to 1150 F. They are built to TEMA standards and to ASME or API-ASME codes.

ALCO heat exchangers are fabricated of carbon steel, nonferrous alloys, stainless steel, stainless clad, nickel-clad, or lead-lined materials. ALCO is one of the very few manufacturers qualified by experience to manufacture equipment suitable for operation at extreme *sub-zero temperatures.*

For details, contact your nearest ALCO Sales Engineer at Beaumont, Chicago, Dunkirk Houston, Los Angeles, New York or Tulsa.



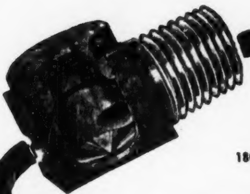


In this chemical plant, twenty-five ALCO heat exchangers meet every type of heat transfer problem from cooling amines to redistillation.

ALCO

ALCO PRODUCTS DIVISION
AMERICAN LOCOMOTIVE COMPANY
Dunkirk, N. Y.

DO YOUR SPRAYS CLOG?



Available in Brass, Stainless Steel and Hard Rubber—or made-to-order in any machinable material. ¼" to 1" I. P. S.

Advanced design features a single round tangential inlet (instead of several small slots). Relatively large solid particles can pass right through and out the orifice. Produces a hollow cone spray with fine break-up and even distribution—ideal for many types of applications.

In many industries Monarch Spray Nozzles are used for:

ACID CHAMBERS
AIR WASHING
CHEMICAL PROCESSING
COOLING PONDS
DESUPERHEATING
GAS SCRUBBING
HUMIDIFYING
OIL BURNERS
SPRAY DRYING

Let us send you Catalogs 6A and 6C

MONARCH MFG. WKS., INC.
2517 E. ONTARIO ST.
PHILADELPHIA 34, PA.

First . . . spray the Colmonoy alloy on. Second . . . fuse it to the base metal.

Two short steps to Longer Life

Spray and weld—that's the easiest, least expensive method of hard-facing pump parts.

Spraying, the first step, is done with a powdered Colmonoy alloy, using the Spraywelder. Fusing the sprayed Colmonoy overlay with an oxy-acetylene flame completes the Sprayweld Process. This forms an integral welded hard-facing.

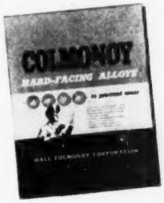
Only Colmonoy hard-facing alloys can be sprayed and fused. Only Spraywelding can give you a smooth overlay that is welded to the part, free of pinholes, within .010" of desired size per side, and so quickly finish machined or ground.

Colmonoy No. 6, the alloy primarily used in Spraywelding, is a nickel-base alloy that stands at the top of its class. It has excellent corrosion resistance, thwarting the actions of most acids and alkalies. It resists abrasion and the effects of oxidation. It does not gall and has a low co-efficient of friction, resulting in longer packing life. Applied with the Spraywelder, Colmonoy No. 6 can't be beaten for reclaiming your pump parts.

Take, for example, the hard-faced pump rod (from an acid sludge pump) shown here. Unprotected rods from the same pump had to be repacked every eight hours and replaced every 24 hours. New rods cost $45, plus installation.

After reclaiming some worn rods with Spraywelded Colmonoy No. 6, the packing lasted sixty hours, eight times longer than before. The rods themselves lasted an average of 573 hours, 23 times as long as did the new unprotected rods. Sprayweld cost was half that of a new rod.

Pump plungers, pistons, seal rings, shafts, bushings, sleeves, and impellers, and valve parts are all benefited with longer life when Spraywelded with Colmonoy alloys.



Write us for the name of the nearest shop doing Sprayweld work. Write, too, for Hard-Facing Manual No. 77. It gives the characteristics of all Colmonoy alloys, and typical jobs on which they are used; also full information on the Sprayweld Process. Engineering Data Sheet No. 3 lists the many acids and alkalies which Colmonoy nickel-base alloys will resist. Write today!

HARD-FACING ALLOYS

19345 JOHN R STREET **WALL COLMONOY** DETROIT 3, MICHIGAN
CORPORATION

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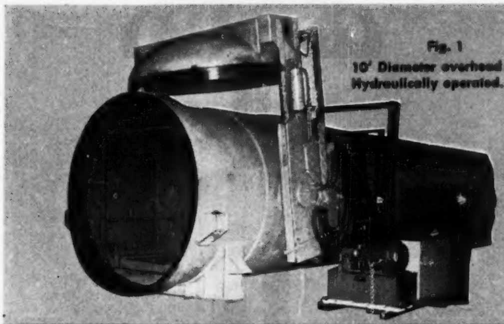


Fig. 1
10' Diameter overhead door. Hydraulically operated.

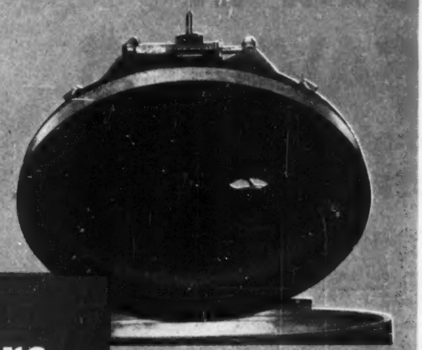


Fig. 2
5' Diameter hinged door for vertical vessel.

Quick Opening Doors

by STRUTHERS WELLS

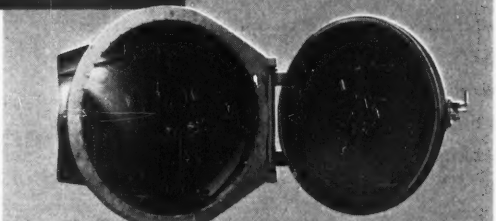


Fig. 3
12' Diameter hinged door for horizontal vessel.

TYPES FOR ALL REQUIREMENTS UP TO 600 PSI WORKING PRESSURE— TO 700°F. MAXIMUM TEMPERATURE

Expanding Locking Ring Door

Struthers Wells expanding locking ring type doors as illustrated in Figures 1, 2 and 3 are made for vertical and horizontal use—in hinged and overhead types. A synthetic rubber gasket is self-sealing and is recommended for use to 400°F steam and pressures to 600 psi, depending on the size of vessel. Made in 3' to 12' diameters.

Lug Type Door

Struthers Wells lug type door (See Fig. 4) features a rectangular asbestos gasket in a groove—for severe operating conditions of temperature and hard to hold chemicals. Quickly and easily operated for rugged service conditions, this type door is furnished with anti-friction hinge bearings, and hydraulic unit for locking and unlocking door.

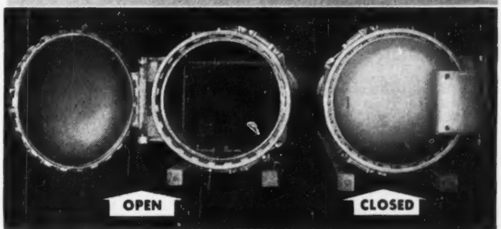


Fig. 4
Ideal for wood preserving operations, hard to hold chemicals and high temperature service.

Struthers Wells

Consult Struthers Wells for Quick Opening Doors best suited to your specific requirements.

STRUTHERS WELLS CORPORATION

Process Equipment Division • **TITUSVILLE, PA.**

Plants at TITUSVILLE, PA. • WARREN, PA. • *Offices in Principal Cities*

Built-in $AVING$

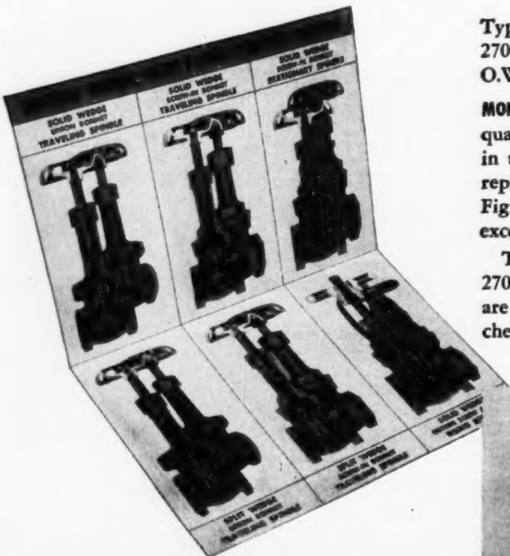
make JENKINS BRONZE GATES your BEST BUY

Look over any of the 35 patterns in Jenkins complete line of Bronze Gates. You'll find *savings* built into every valve. Jenkins valve specialists designed each one for easy maintenance and extra long wear. Try them on your toughest services and see why they take top-rating in any test for endurance and economy. Jenkins Bros., 100 Park Ave., New York 17.

Typical of Jenkins design for built-in savings are the Fig. 270-U and Fig. 270-UN Gates for 200 lb. Steam, 400 lb. O.W.G. services.

MONEL AND BRONZE SEATING COMBINATION In Fig. 270-U a high quality bronze wedge seats against MONEL rings expanded in the body. The wedge takes the wear — it can easily be replaced when necessary by slipping a new one on the stem. Fig. 270-UN, with a nickel alloy wedge, is recommended for exceptionally severe conditions of rapid wear and corrosion.

These and other features of rugged construction make Figs. 270-U and 270-UN first choice for economy where conditions are most destructive to valves, as in oil refineries, dye houses, chemical, food, and rubber plants.



Jenkins Bronze Gate folder shows the many types available — lists convincing reasons why they are your best buy for any service. Ask for Form 181-A.

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LOOK FOR THE DIAMOND MARK
VALVES
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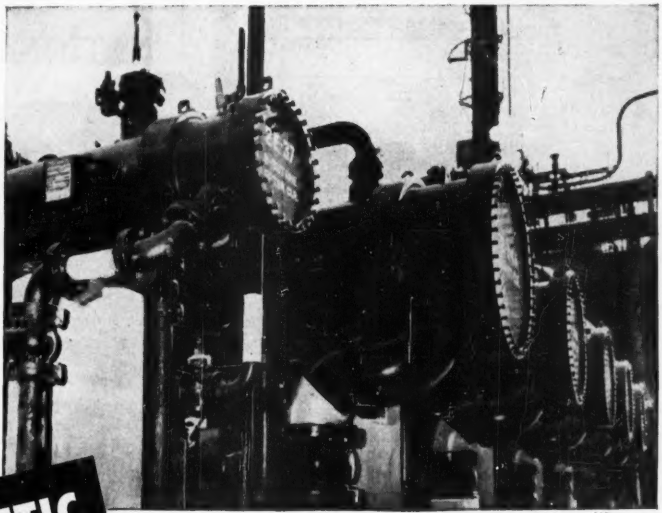
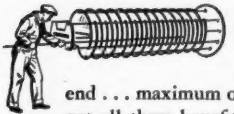
SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS



SYNTHETIC RUBBER

...another industry that uses HUNDREDS OF MILES of REPUBLIC

ELECTRUNITE PRESSURE TUBES



Uniform strength *all around the tube* at elevated operating temperatures . . . uniform corrosion resistance *all around the tube* and from end to end . . . maximum on-stream service helps lower annual cost . . . you get all these benefits when you retube with Republic ELECTRUNITE Pressure tubes . . . or specify them for new heat exchangers.

Whatever your products . . . whether you require carbon steel or stainless steel tubes . . . let us tell you why you'll get more hours of production with less down-time and lower cost per year from Republic ELECTRUNITE Heat Exchanger Tubes . . . they're proved by millions of hours of service—in thousands of heat exchangers and condensers in scores of industries.

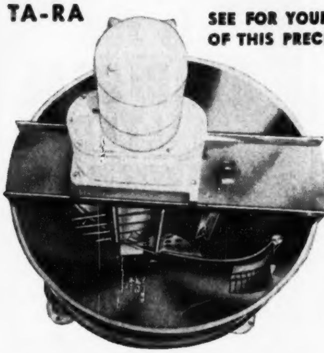
REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
224 East 131st Street • Cleveland 8, Ohio

REPUBLIC STEEL

ELECTRUNITE

BORROW this Mixer Kettle . . . and test it in Your plant

MODEL TA-RA



SEE FOR YOURSELF HOW THE 4-WAY VERSATILITY OF THIS PRECISION MIXER CAN SAVE YOU MONEY

Why guess when you buy mixing equipment? Test first . . . and be sure! Borrow one of our versatile MODEL TA-RA Stainless Steel Steam Jacketed Agitator Kettles for a reasonable time AT NO COST (except freight from and to Chicago or next destination). Then experiment on your own processing. See exactly what speeds you need and what equipment is required to do your work perfectly. MODEL TA-RA is a special combination of our Model TA Twin Shaft and our Single Shaft RA Model. Has variable speed drive . . . extra-high speed Rota-Therm steam jacket . . . and all equipment for excellence in every kind of mixing from violent whipping to simple stirring, scraping or swirling actions. Using all or parts of the equipment you determine accurately what gives best results. It's a great plan. Write for details now.

Send for FULL DETAILS TODAY!

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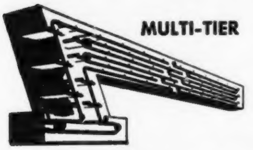
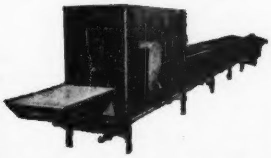
for Bakery, Confectionery, Food, Chemical and Allied Industries



MULTI-TIER

Greer engineers are prepared to work with you on plant layout and to design special applications of the Greer Multi-Tier Conveyor for your particular product. Our wide experience with installations of this machine in many different industries can be invaluable in helping to convert from batch methods to continuous processing or to further simplify and streamline your present production processes. The Multi-Tier is the real answer to compact production and space-saving economy.



COOLING TUNNEL

As an alternate to the Multi-Tier where shorter production periods are required, the Greer Cooling Tunnel offers the most efficient answer where controlled temperatures and air circulation are a factor. Thirty years of developing and building such equipment makes these units available in widths ranging from 16″ to 52″ and lengths variable by 8′. The special sectional steel belt offers a feature which provides the most efficient cooling obtainable.

GREER J. W. GREER COMPANY

119 WINDSOR STREET, CAMBRIDGE 39, MASS.

TEFLON by ETHYLENE

made by SPECIALISTS

Because we produce only Teflon our full resources and attention are devoted to the production of Teflon and to the solution of your Teflon problems.

Immediate delivery of standard stock sizes of Teflon rods, sheets, molded and extruded tubing from our plant or from the following distributors:

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Ray Miller Company 4234 Kanawha Tpke. So. Charleston, W. Va.	Ray Miller & Co. 1210 Hays Street Houston, Texas

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245 Broad Street, Summit, New Jersey

Please mail ____________ copies of price and size lists to:

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NEW HEAT SAVING EFFICIENCY

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- *Custom Molded Precision Pipe Fit*
- *Attractive, Smooth Finish*

Now available in pipe covering and block insulation, Mundet 85% Magnesia permits new heat-saving efficiency. Precision manufacturing on the latest type of automatic equipment insures uniform standards. Extra durability is built into the insulation. It does not "powder", settle or disintegrate. It is unaffected by either steam or water leakage. It maintains an attractive, smooth finish. Precision pipe fit is assured, with no spaces left for the escape of heat. You benefit from the most modern manufacturing facilities for the production of heat insulation. Write for specification information and recommendations. Mundet Cork Corporation, Insulation Division, 7101 Tonnelle Avenue, North Bergen, N. J.

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specialists in **prefabricating pipe**

Albert's Prefabrication meets the most exacting specifications for Oil, Chemical, Concrete, Asphalt, and other Industrial requirements.

Butt Welds • Bending All Types • Coiling • Machining • Threading • Beveling • Lining • Pickling • Galvanizing • Sand Blasting • Preheating • Stress Relieving • Testing •

Pipe—Wrought Iron-Steel • Seamless • Electric Weld • Spiral Weld • Lap Weld • Butt Weld • Shore Dredge • SPEED-LAY •

Piling — Sheet piling-lightweight-Tubular all sizes.

Pile Fittings — All types and sizes for steel and wood.

Write for Free Prefabrication Booklet.

ALBERT pipe supply co., inc. BERRY AT NORTH 13TH ST. • BROOKLYN 11, N. Y.

ANTHRAFILT*

Is the HARD COAL FILTER MEDIUM that SAVES IN many, many ways

You save in many ways when you use ANTHRAFILT*. . . an outstanding hard coal filter now enjoying widespread use in industry. No water soluble constituents remain in ANTHRAFILT* to contaminate or contribute tastes or odors to filtered solutions. The reason: practically all minerals other than the inherent ash are removed during preparation. Filters acetic and sulfuric acid, caustic soda solutions, boiler condensate, sanitary and process water.

ANTHRAFILT*

provides:

- **GREATER CAPACITY**
- **LONGER FILTER RUNS**
- **CLEANER WASHINGS AT LOWER COST**
- **REMOVES ENTRAINED TURBIDITY FROM INDUSTRIAL PROCESS SOLUTIONS OR WASTES**

We invite you to write us today for full details and recommendations. A prompt reply is assured.

PALMER FILTER EQUIPMENT COMPANY
822 East 8th St., P. O. Box 1655, Erie, Pa.

*Trade Mark Reg. U. S. Pat. Off.

ANTHRACITE EQUIPMENT CORPORATION
Anthracite Institute Building
WILKES BARRE PA.

THIS QUARTER-INCH KEEPS EVERY BIG INCH *alive!*

EVER see them lay a gas or oil pipeline like *this?* We mean the "big inchers" you could crawl through. They're so vital that industry is laying millions of dollars worth of new ones every year.

Unprotected, these underground steel arteries would soon rust away. But industry has developed a life-saving sheath for them and often, the main protective material is Pitt Chem Tar Base Pipeline Enamel—an impervious product of coal.

As a *basic* and *integrated* producer of coal chemicals and related products, we closely control *quality* from coal to finished coatings. That's why Pitt Chem Enamels perform better in application and service.

Whether you're considering protective coatings, or the products of any of our other integrated divisions, you'll find that it pays to buy from a basic producer.

- ★ Standard Grade Tar Base Enamel
- ★ Modified Grade Tar Base Enamel
- ★ Plasticized Grade Tar Base Enamel
- ★ Cold Applied Tar Base Coatings
- ★ Synthetic Base Coatings

W&D 3960

PROTECTIVE COATINGS DIVISION

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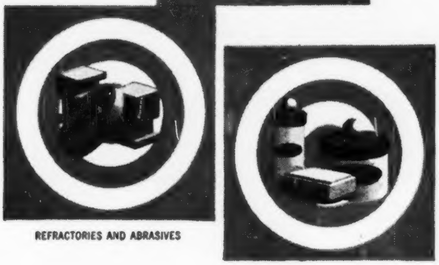
COAL CHEMICALS • AGRICULTURAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

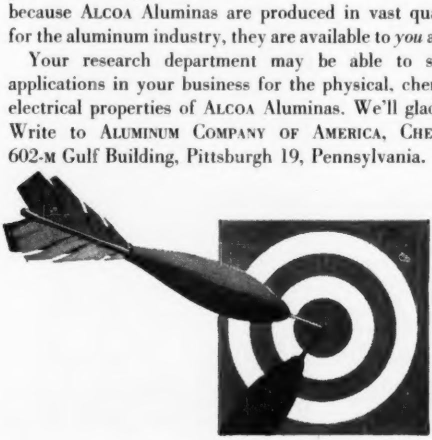
Alcoa Aluminas can help you make a hit!



What do you make? Aim to make it *better?* Then investigate Alcoa Aluminas.

These versatile Alcoa aluminum oxides are used widely throughout industry to improve many products. They speed up processes, promote chemical reactions, cut production costs. They make products stronger, more resistant to shock and heat. Moreover, because Alcoa Aluminas are produced in vast quantities primarily for the aluminum industry, they are available to *you* at reasonable cost.

Your research department may be able to suggest profitable applications in your business for the physical, chemical, thermal or electrical properties of Alcoa Aluminas. We'll gladly send samples. Write to Aluminum Company of America, Chemicals Division, 602-m Gulf Building, Pittsburgh 19, Pennsylvania.

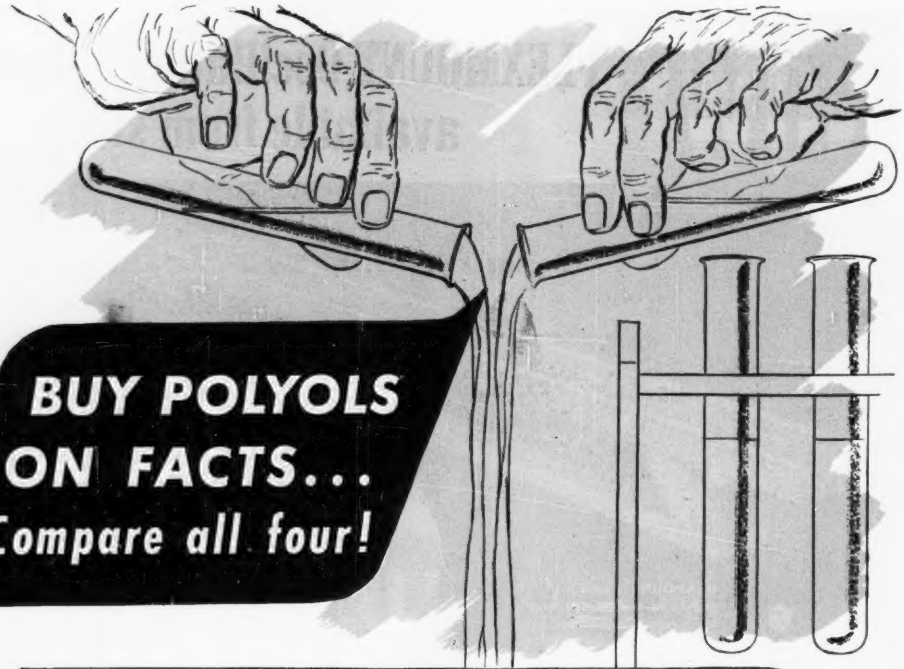


Alcoa Chemicals

ALCOA ALUMINUM

ALUMINAS and FLUORIDES

ACTIVATED ALUMINAS • CALCINED ALUMINAS • HYDRATED ALUMINAS • TABULAR ALUMINAS • LOW SODA ALUMINAS ALUMINUM FLUORIDE • SODIUM FLUORIDE • SODIUM ACID FLUORIDE • FLUOBORIC ACID • CRYOLITE • GALLIUM



BUY POLYOLS ON FACTS... Compare all four!

FACT: ***Sorbitol leads in compatibility***

Atlas sorbitol is compatible with other polyhydric alcohols, sugar syrups, glues, dextrins, sulfonated oils, and other materials normally encountered in conditioning problems.

FACT: ***Sorbitol leads in performance***

Sorbitol and related Atlas polyols frequently outperform similar polyhydric alcohols. Sorbitol has a better taste; greater purity and *uniformity*. It has a narrower humectant range than other conditioners and is chemically stable. In addition, sorbitol is utilized by the human body as food.

FACT: ***Sorbitol leads in availability and price stability***

Sorbitol, made from sugar, is available in almost unlimited quantities. And the price trend of sorbitol continues downward as production increases. In price stability alone, sorbitol rates the "best buy."

Write today for the valuable 22-page Atlas sorbitol book containing charts, usage tables, and other helpful data. Personal technical assistance is available at your request.

Industrial Chemicals Department

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ATLAS POWDER COMPANY, CANADA, LTD., BRANTFORD, CANADA

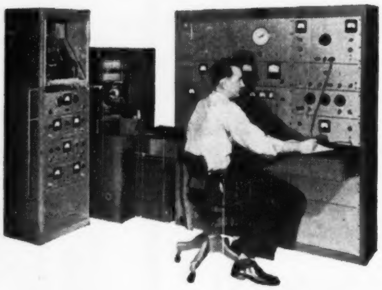
now.... spectro-SADIC...

. . . great new adjunct to the analytical mass spectrometer

COUPLED to the widely used Consolidated Analytical Mass Spectrometer, the new Spectro-SADIC supplies preselected analytical data for both gaseous or liquid mixtures in directly read *numerical* form, thus accomplishing tremendous savings in time and computing manpower, and, at the same time, eliminating human error.

The combination of a 21-103 Mass Spectrometer, the Spectro-SADIC, and its associated equipment — typewriter or standard punched-card apparatus — can bring to a wide variety of plant processes the benefits of rapid, precise, quantitative analyses often impossible by other methods.

A CEC Field Engineer will be glad to detail the advantages as they apply to your specific process.



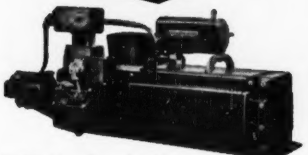
Consolidated Engineering
CORPORATION
300 North Sierra Madre Villa, Pasadena 15, California

Sales and Service through **CEC INSTRUMENTS, INC.**, *a subsidiary with offices in: Pasadena, Philadelphia, Chicago, Dallas.*

analytical instruments for science and industry

Complete information on the CEC Analytical Mass Spectrometer is contained in Bulletin CEC 1800B; the Spectro-SADIC is described in Bulletin CEC 3001A.

ACCURATE PROCESS CONTROL *with* W&T MERCHEN FEEDERS



W&T Merchen Scale Feeder

Successful process control — particularly in today's modern, high-speed plants — generally depends on the accurate feeding of dry, free-flowing, chemicals. Continuous, precision feeding — *by weight* — is essential to a uniform end product. And that's what W&T Merchen Scale Feeders can demonstrate in *your* plant, just as they are doing in hundreds of others.

Merchen Feeders are widely used both for the blending of several dry chemicals and for the addition of one or more dry chemicals to a liquid.

These feeders will handle from a few ounces to several thousand pounds per minute — and, of particular importance in many plants, they can be completely synchronized with other equipment, or equipped for remote or automatic control. For example, Merchen Feeders are equipped to stop automatically and at the same time stop all other synchronized process equipment if the delivery of material for any reason should vary from the rate of feed pre-set on the scale beam.

SERVICE — A nationwide service organization is prepared to suggest the proper W&T Merchen Feeders for your process and to give prompt service and installation supervision on Merchen Equipment.

Write today for additional information on W&T Merchen Scale Feeders.

WALLACE & TIERNAN COMPANY, INC.

NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

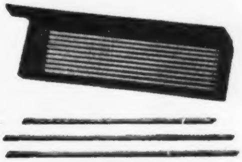
WESTON TAG

Thermometers

in all forms—ranges—stem lengths—connections

Whether your requirement calls for certified laboratory thermometers . . . or rugged all-metal industrial types . . . or thermometers for remote reading . . . you'll find *exactly* what you require in the Weston-TAG line—*the most comprehensive line of quality thermometers ever offered by ONE manufacturer.* Literature on request. WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey.

Laboratory



ALL-METAL

—have readable, dial-type scales and corrosion-resisting stainless steel stems—stem lengths from 2" to 24"—ranges from low as −100°F. to high as 1000°F.—accuracy ½ of 1% of thermometer range.

GLASS

—certified sets of ASTM Testing thermometers with overlapping ranges in protective case. Ranges from −36°F. to high as 760°F. Also precision and standard etched stem thermometers for general testing.

Industrial

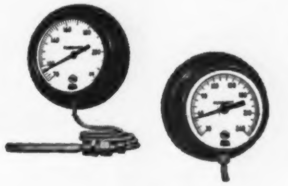
ALL-METAL

—provide unmatched readability and durability—accuracy within 1% of thermometer range. Available in all types, ranges and stem lengths (2½" to 72") for all requirements.

GLASS (Metal Case)

—available in all forms, all ranges, stem lengths and connections. Accuracy within one scale division. Also submarine types, metal and cupcase thermometers.

Remote Reading



ELECTRICAL

—resistor bulb sensing element permits mounting indicator any distance away from point of measurement. *Multiple* remote readings also possible by use of selector switch and several bulbs.

PRESSURE ACTUATED

—for remote reading, in 5, 6 and 8" dial sizes. Ranges from low as −325°F. to high as 1000°F. Accuracy one scale division unaffected by vibration or severe shock. Cases of iron, brass, or plastic.

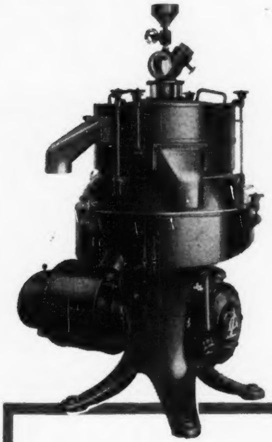
WESTON *Temperature Instruments*

—TO INDICATE — RECORD — CONTROL

9413

NO TIME FOR

INTERRUPTION!



Continuous motion is often important—and never more so than in processing. A chemical or food process should never be stop-and-go. To be profitable, each step . . . and that includes separation and clarification . . . should build on each previous step.

De Laval centrifuges take the interruption out of (1) liquid-liquid, (2) liquid-solid, and (3) liquid-solid-and-liquid separation by making each one continuous.

De Laval machines are designed to separate at constant efficiency throughout a long run. Their bowls do not store solids in the stream of liquid being separated, but either store the removed impurities against the periphery of the bowl (where they cannot interfere with the incoming flow) . . . or, in the case of the Nozzle-Matic Separators, discharge the solids along with some of the heavy liquid.

● It will be helpful if you mention what you want to separate when you write.

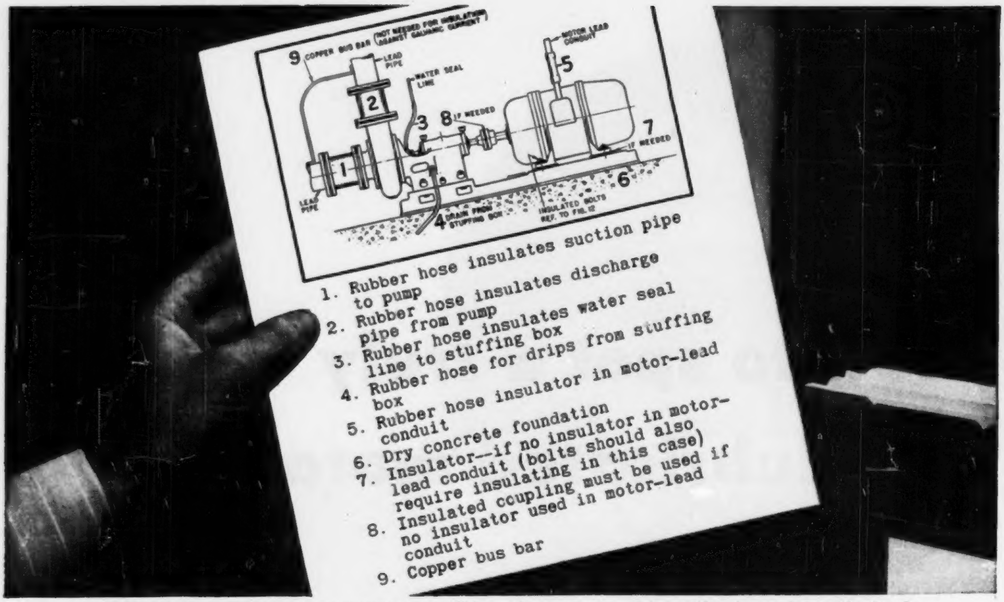
CONTINUOUS OPERATION
is all-important in processing
- ***to speed production***
- ***cut costs***
- ***improve quality***

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York   427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL

for CONTINUOUS Separation with Centrifugals

WHAT *Life-Lines* REALLY DELIVER IS MORE SERVICE...LESS SERVICING



ANOTHER CASE STUDY FROM THE WORTHINGTON FILES. This data sheet from the Worthington files indicates points at which an alloy pump should be insulated in order to eliminate stray-electric-current corrosion in an electrolyte circulating system. The solution to this problem was arrived at from very careful consideration and investigation by Worthington engineers working in conjunction with the pump user. The resulting installation—made some eleven years ago—was one of the first in the world where alloy (Worthite) pumps were used to circulate an electrolyte.

Another Pumping Problem That Called For More Than a Pump!

A check of the Worthington files would uncover many stories like this one. They're the best evidence we have of the "extras" you get with every Worthite* pump.

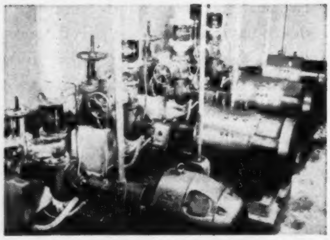
About eleven years ago Worthington specialists solved this problem of protecting pumps from stray current corrosion. As a result, Worthite pumps were installed in the manner illustrated above in the data sheet.

Today, after examination, there is practically no corrosion on the pumps. A life of 20 to 30 years is indicated for these Worthite pumps. Maintenance costs are a fraction of what they had been before. And the Worthite units required only 40 hp as compared to 75 hp for previously used (lead) pumps. They still deliver more electrolyte and have not fallen off in capacity after eleven years service.

During the same eleven years, copper and zinc refineries everywhere in the world have been specifying Worthite pumps for electrolyte circulation. Old refineries now modernize with them. Once again, Worthington's 111-year experience with pumping equipment helped to solve a tough problem for industry.

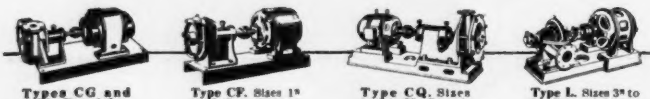
At Worthington, we'd like to hear about your pumping problems. Write Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.

*Reg. U. S. Pat. Off.



THIS ALLOY PUMP INSTALLATION FOR ELECTROLYTE CIRCULATION is comprised of these Worthite centrifugal pumps, 6-in. discharge by 8-in. suction. They circulate copper sulfate electrolyte and have been in service for eleven years without any indication of stray-electric-current corrosion. Note how pumps are insulated.

C.2.1



Types CG and CGL. Sizes ¾" to 10". Capacities to 5000 GPM; heads to 200 ft. Liquid ends of WORTHITE.

Type CF. Sizes 1" to 4". Capacities to 1000 GPM; heads to 130 ft. Standard, all iron and all bronze.

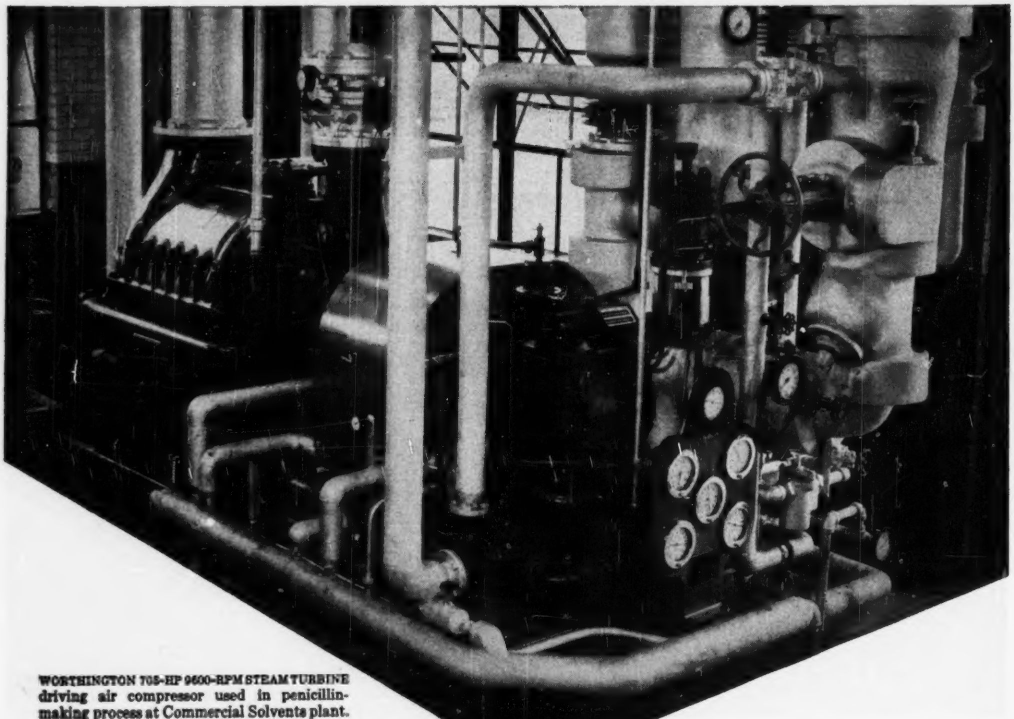
Type CQ. Sizes 1½" to 3". Capacities to 600 GPM; heads to 130 ft. at 1750 RPM. Closed impeller.

Type L. Sizes 3" to 8". Capacities to 2250 GPM; heads to 300 ft. Single stage volute. For general service.

WORTHINGTON

Centrifugal Pumps

The World's Broadest Line Assures You the Right Pump for Every Job



WORTHINGTON 705-HP 9600-RPM STEAM TURBINE driving air compressor used in penicillin-making process at Commercial Solvents plant.

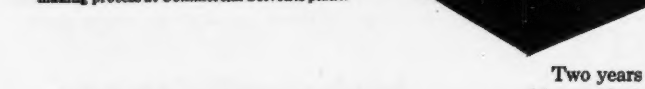
9600-rpm turbine drives compressor in making penicillin for Commercial Solvents Corp.

Two years ago, a Worthington high-speed steam turbine was installed in the Terre Haute, Indiana, penicillin plant of Commercial Solvents Corporation. Its high efficiency and economical steam consumption plus its low maintenance demands have justified that selection many times over.

In addition, use of Worthington high-speed, direct-drive turbines to drive centrifugal compressors or blowers makes possible a broad speed range, elimination of costly speed increasing gears, and adaptability to various governing arrangements for precise control under all operating conditions. Worthington's design flexibility provides you with the *right* type and size turbine for optimum performance—regardless of your requirements.

Remember, when you're considering turbines for driving compressors, the engineering of the turbine is just as important as the engineering of the compressor. Worthington's long and complete experience in compressor-drive engineering is your assurance of maximum efficiency. Write for Bulletin 1966 to Worthington Corporation, Steam Turbine Division, Wellsville, N. Y.

T-2-19



A GREAT TEAM IN STEAM

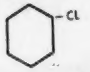
WORTHINGTON

Steam Turbines

HOOKER SOLVENTS

Hooker Chemical Guide
(ONE OF A SERIES)
USE this handy reference to save time in selecting high-quality chemicals.

MONOCHLOROBENZENE



Synonym: Phenyl Chloride
Formula: C_6H_5Cl
Molecular Weight: 112.5
Appearance: Clear, colorless liquid

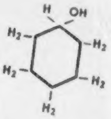
TYPICAL PROPERTIES

Freezing Point	−44° C
Distillation Range	131.2° to 132.2° C
Specific Gravity, 15.5°/15.5° C	1.114

USES

- INSECTICIDAL INTERMEDIATE: DDT and other insecticides.
- DYESTUFF INTERMEDIATE: Sulfur black and brown dyes.
- CHEMICAL INTERMEDIATE: Organic synthesis.
- SOLVENT: Paints, varnishes, lacquers, paint removers; general use.
- HEAT TRANSFER FLUID: Suggested for condensing vapor systems, such as glass-enameled vessel jackets, which cannot stand high steam pressures.

CYCLOHEXANOL



Synonym: Hexahydrophenol
Formula: $C_6H_{11}OH$
Molecular Weight: 100.1
Appearance: Viscous, colorless liquid with pleasant, aromatic odor.

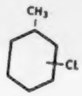
TYPICAL PROPERTIES

	High Grade	Tech. Grade
Freezing Range	18° to 22° C	−10° C to −20° C
Boiling Point	161.7° C	161.7° C
Specific Gravity, 25°/15.5° C	0.945	0.939
Flash Point	67° C	61° C

USES

- SOLVENT: For resins, metallic soaps, dyes, fats and oils.
- BLENDING AND STABILIZING AGENT: In textile soaps and dry cleaning agents.
- HOMOGENIZING AGENT: For lacquers, varnishes and paints.
- ALSO USED: In furniture and metal polishes, shoe creams, floor waxes, degreasing of leather, lubricating oils, also a plasticizer and ingredient of adhesives, and as a chemical intermediate in organic synthesis.

MONOCHLOROTOLUENE



Synonym: Methylchlorobenzene
Formula: $CH_3C_6H_4Cl$
Molecular Weight: 126.5
Appearance: Clear, colorless to straw-colored liquid.

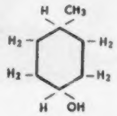
TYPICAL PROPERTIES

Freezing Point	below −45° C
Distillation Range	158.3° to 161.7° C
Specific Gravity, 15.5°/15.5° C	1.080

USES

- SOLVENT: Rubber and synthetic resins.
- INTERMEDIATE: Manufacture of rubber accelerators, chemicals.

METHYL CYCLOHEXANOL



Synonym: Hexahydrocresol
Formula: $CH_3C_6H_{10}OH$
Molecular Weight: 114.1
Appearance: Light straw-colored, neutral, viscous liquid.

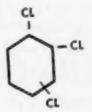
TYPICAL PROPERTIES

Distillation Range	155° to 180° C
Specific Gravity, 15.5°/15.5° C	0.924
Flash and Fire Points	71° C

USES

- SOLVENT: For cellulose acetate, nitrocellulose and other cellulose esters for lacquers and coating compositions.
- ANTI-OXIDANT: In lubricants.
- BLENDING AGENT: For special textile soaps and detergents.

TRICHLOROBENZENE, Tech.



Formula: $C_6H_3Cl_3$
Molecular Weight: 181.5
Appearance: Clear, almost colorless liquid

TYPICAL PROPERTIES

Freezing Point	10° C
Distillation Range	5° incl. 216° C
Specific Gravity, 15.5°/15.5° C	1.466

USES

- INSECTICIDE: Soil poison for termites.
- SOLVENT: Fats, oils, waxes, resins; crystallization solvent.
- HEAT TRANSFER MEDIUM: Condensing vapor systems, 210° to 300° C.
- DIELECTRIC FLUID: Transformers.
- INTERMEDIATE: Dye intermediates, other organic chemicals.

• *For more information on items listed, drop a note on your letterhead to:*

HOOKER ELECTROCHEMICAL COMPANY
5 Forty-Seventh St., Niagara Falls, N. Y.

HOOKER ELECTROCHEMICAL COMPANY

NIAGARA FALLS, N. Y. • NEW YORK, N. Y.
TACOMA, WASH. • CHICAGO, ILL. • WILMINGTON, CALIF.

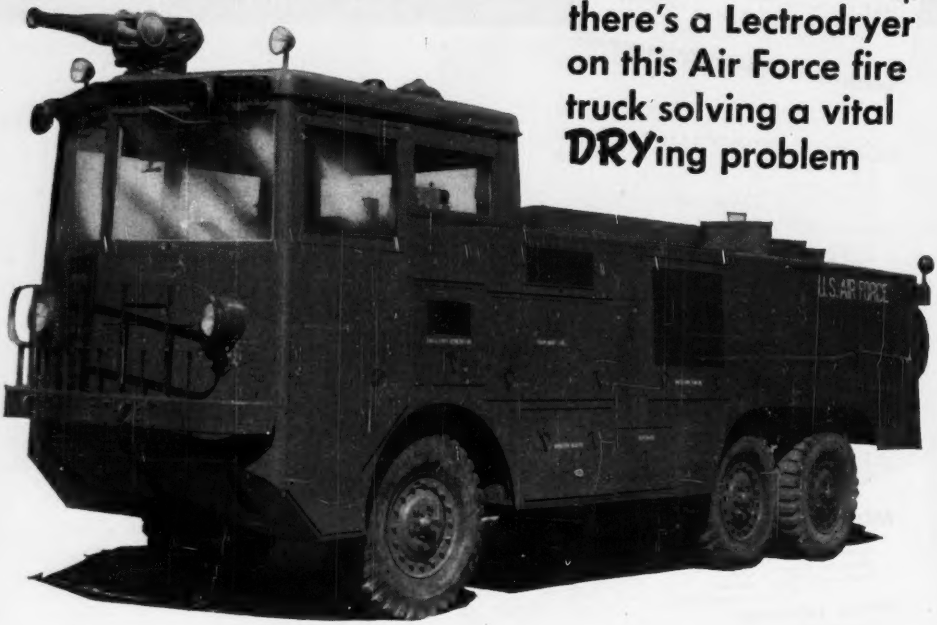
From the Salt of the Earth

HOOKER CHEMICALS

2-1520

The story's **RESTRICTED** but

there's a Lectrodryer* on this Air Force fire truck solving a vital DRYing problem



Adding to the DEPENDABILITY of this equipment is Lectrodryer's role aboard this crash fire truck, just as it is throughout industry generally. A Lectrodryer removes unwanted moisture from air, gases and organic liquids to dewpoints below $-110°$ F., thus helping to speed production and maintain high quality.

LECTRODRYER is the name of a large family of DRYing machines. They range in size from the tiny Laboratory Model, capable of handling a few cubic feet per hour, to giant wind tunnel installations handling tons of air per minute. They work at atmospheric pressure or as much as 5,000 psi., manually or automatically controlled.

Lectrodryer engineers can advise you on the DRYing equipment you'll need for any job, basing their recommendations on nearly twenty years' experience in DRYing. No need for your men to take valuable time on such problems. For this help, write Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In Australia: Birlec, Limited, 51 Parramatta Road, Globe, Sydney.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U. S. PAT. OFF.

Aluminum VALVES for the CHEMICALS and PROCESS Industries

In the amazingly wide variety of materials* used in Powell Corrosion-Resisting Valves, Aluminum is very important. The Powell Line of Aluminum Valves, including all types and also many special designs, is a really outstanding contribution to the Chemicals and Process Industries.

The Wm. Powell Co., Cincinnati 22, Ohio

*Available in the greatest variety of corrosion-resisting Metals and Alloys ever used in making valves.

DEPENDABLE VALVES SINCE 1846

Fig. 1876—Aluminum Gate Valve for 100 pounds W. P. Screwed-in bonnet, inside screw rising stem. Stainless steel stem and solid or split wedges. Sizes, ¼" to 2", inclusive. Valves with flanged ends also available.

Fig. 1878—Aluminum Globe Valve for 100 pounds W. P. Union bonnet. Sizes 2½" and 3" have bolted flanged bonnet. Stainless steel stem, composition disc. Sizes, ¼" to 3", inclusive. Also available with flanged ends.

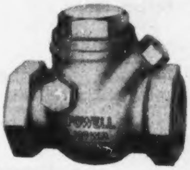


Fig. 2058—Aluminum Swing Check Valve for 100 pounds W. P. The hinge pin is made of stainless steel. The aluminum disc is hung on a 45 degree angle and is held to disc carrier by a locknut pinned to disc stem. Valves can be used in horizontal or vertical position. Sizes, ¼" to 3", inclusive. Flanged end valves also available.

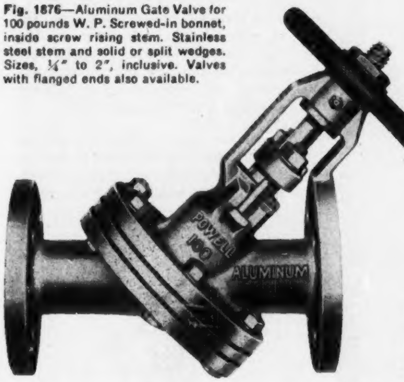


Fig. 1097 — Aluminum "Y" Valve for 100 pounds W. P. Separable body, reversible seat, outside screw and yoke. The reversible and renewable seat plate, disc, stem and locknut are stainless steel. Stem is threaded and rises through a revolving bushing. Lower half of body can be unbolted and turned through an arc of 180 degrees to make a 90 degree angle valve to accommodate special piping arrangements and to eliminate extra fittings. Sizes, ½" to 4" inclusive.

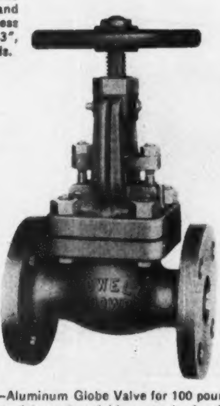


Fig. 2445—Aluminum Globe Valve for 100 pounds W. P. Bolted flanged bonnet, outside screw and yoke. Stainless steel stem is threaded and rises through a bronze bushing in upper yoke. Composition disc. Sizes, ¼" to 3", inclusive. Valves with screwed ends also available.

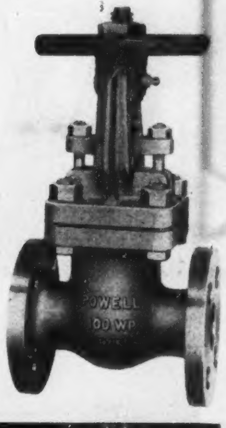


Fig. 2443—Aluminum Gate Valve for 100 pounds W. P. Bolted flanged bonnet, outside screw and yoke. Stem rises through revolving bushing in upper yoke. Stainless steel stem and solid or split wedges that are interchangeable, precision-fitted, and are accurately guided throughout entire travel. Sizes, ½" to 2", inclusive. Screwed end valves are also available.

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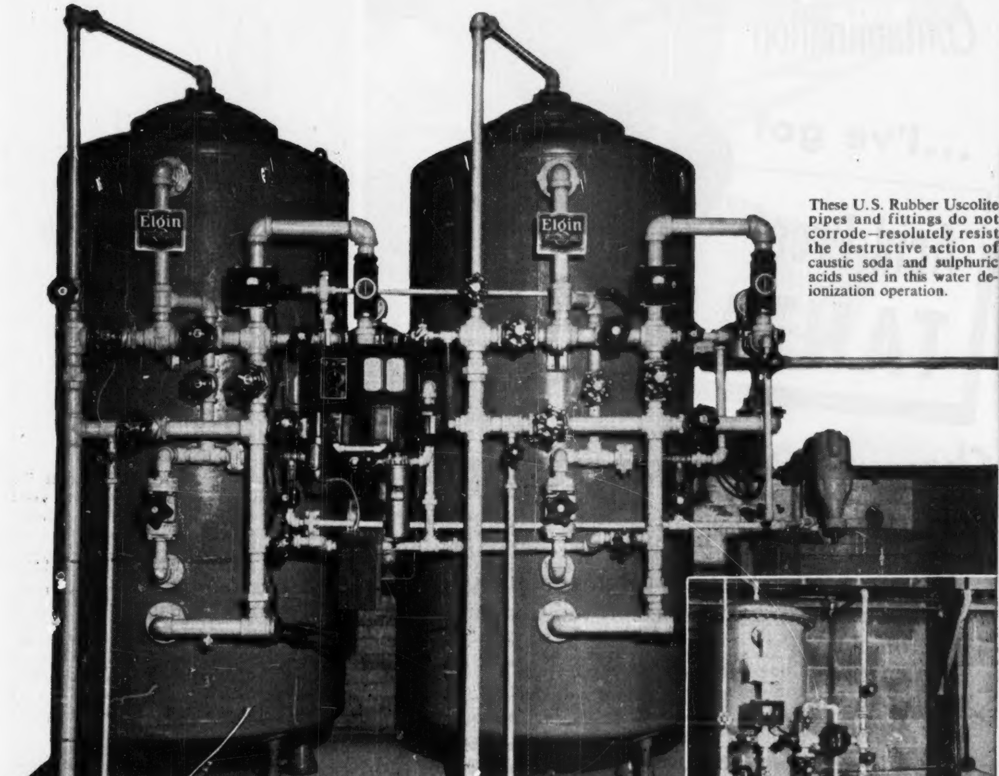

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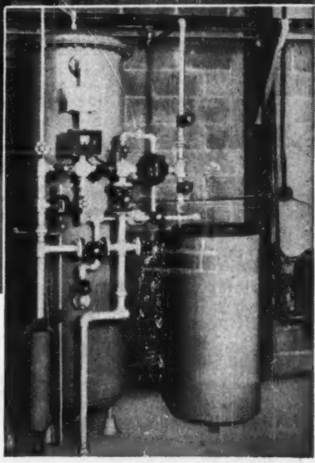

Inside and outside this ultra De-Ionizer, Uscolite pipes are used. Unlike other plastic pipes, Uscolite is not brittle, does not swell, will not contaminate water as metal piping does.
Photos courtesy of Elgin Softener Corp.

Product of U.S. RUBBER SERVING THROUGH SCIENCE

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

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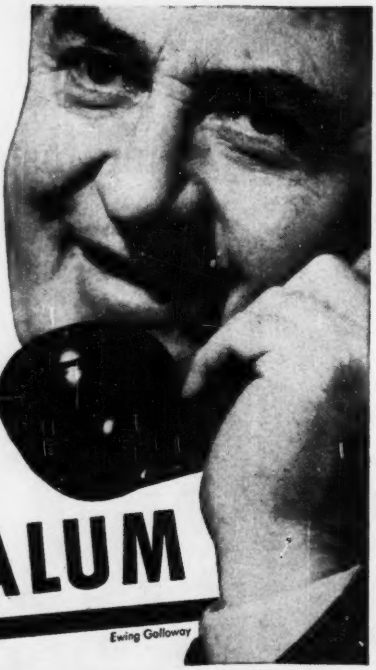

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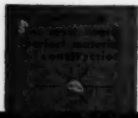

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THE MAN WE MEAN IS A COMPOSITE of the editorial staff of this magazine. For, obviously, no one individual could ever accomplish such a vast business news job. It's the result of many qualified men of diversified and specialized talents.

AND, THERE'S ANOTHER SIDE TO THIS "COMPOSITE MAN," another complete news service which complements the editorial section of this magazine – the advertising pages. It's been said that in a business publication the editorial pages tell "how they do it" – "they" being all the industry's front line of innovators and improvers—and the advertising pages tell "with what." Each issue unfolds an industrial exposition before you – giving a ready panorama of up-to-date tools, materials, equipment.

SUCH A "MAN" IS ON YOUR PAYROLL. Be sure to "listen" regularly and carefully to the practical business information he gathers.

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WITH A SANDVIK WATER-BED CONVEYOR YOU CAN:

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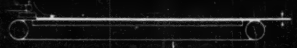
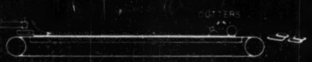
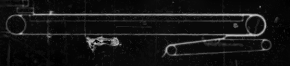


REGULATE THICKNESS WHILE COOLING (ANY THICKNESS UP TO 1 CAN BE COOLED)



CUT MATERIAL TO DESIRED SIZES WHILE COOLING



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COOL LOOSE AND PULVERIZED MATERIALS

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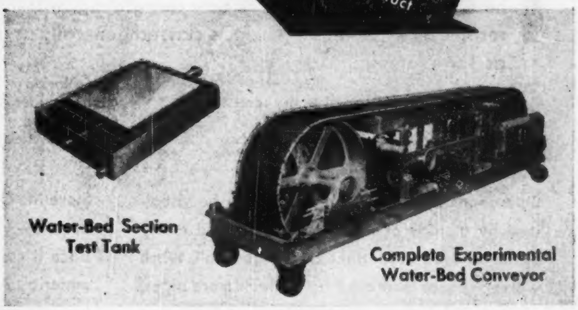
HOW CAN SANDVIK'S NEW COOLING CONVEYOR *Improve YOUR production?*

HERE ARE TWO WAYS To "Pre-Test" Sandvik's Steel-Belt, Water-Bed Conveyor With Your Own Product



Water-Bed Section Test Tank

Complete Experimental Water-Bed Conveyor

With one of these experimental units you can find out how Sandvik's patented water-bed conveyor can make your processing more automatic.

A small scale trial in your plant will enable you to determine cooling rates and other pertinent data. You will see for yourself the extraordinary cooling capacity of this conveyor combined with the advantages of the steel belt.

How The Water-Bed Conveyor Operates—The loaded steel band "floats" along on an open trough of circulating water. The water pressure assures 100% coolant contact with the belt. The trough is so designed that no water can get on top of the belt.

Experimental water-bed units are available on request. Sandvik's engineering department will help you decide which test unit is best suited for your purpose. Write, wire or 'phone for complete details.

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Conveyor Department
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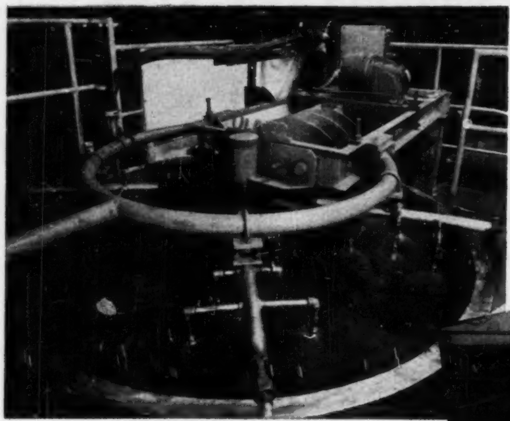
WAtkins 9-7180
Manufacturers of Steel-Belt Conveyors For Over 30 Years

SANDVIK STEEL BELT CONVEYORS

SS-64

OLIVER HORIZONTAL FILTER



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a . . . because you get exceptionally high filtering capacity

b . . . because you get excellent washing results; counter current, if desired

c . . . because gravity aids *all* flow at *all* times

d . . . because you can always see all the action on the table

The Oliver Horizontal Filter is now dewatering, washing and extracting with excellent results, many different products classed generally as granular, crystalline and fibrous, as for example:

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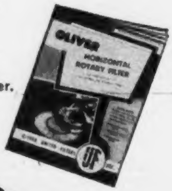
foundry sand	copper pyrites	polyvinyl chloride
feldspar	cotton linters	monosodium glutamate
caustic salt	sodium chloride	phosphate rock concentrates
carbon	potash	oil extraction from meals

Operations are simple, as can readily be visualized by a study of the photograph. Feed enters at the dam just beyond the discharge scroll. Wash water or liquor is sprayed from one or more pipes, spaced at selected intervals. Cake is discharged by scroll or paddle wheel. Each of these operations is completely visible to the operator.

Since the Oliver Horizontal comes in a wide range of sizes—4 to 165 square feet of filter area — and since it can be constructed of corrosion resisting materials — consider its use in *your* plant regardless of tonnage or corrosives to be handled.

Bulletin 218-R gives full details of the Oliver Horizontal Filter. Send for your copy.



The Oliver Horizontal Filter is but one of nearly a score of distinctly different filters. This wide selectivity plus 45 years of filtration experience assures you of the most suitable filter for your problem.

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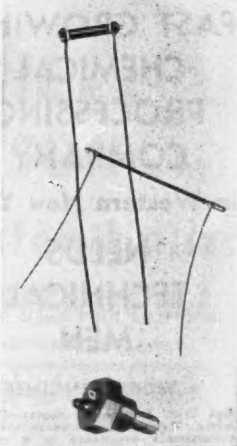

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REPLIES (Box No.): Address to office nearest you
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CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

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(Additional Position Vacant Ads on the following page)

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TECHNICAL LIBRARIAN: Wanted by Research Division of progressive, expanding Petroleum and Chemical Company, located in Mid-south. P-6142, Chemical Engineering.

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Call, write, or wire
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SALARIED PERSONNEL, $3,000-$25,000. This confidential service, established 1927, is geared to needs of high grade men who seek a change of connection, under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. B, 241 Orange St., New Haven, Conn.

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ENGINEER-CHEMICAL B.S. degree. 3 years experience as plant sup't of small Chemical Plant. Desire like position with good future. Age 33. PW-6041, Chemical Engineering.

(Continued on the following page)

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Send complete resumes to

P-6029, Chemical Engineering
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ANNOUNCEMENT

I have recently severed my connection with Consolidated Products Company, Inc. and have resigned as Secretary and Treasurer. I would like to express my grateful appreciation for all the friendships and good will that have come to me from this Industry in the past 30 years during which I was part of "Consolidated". At this moment I have no future plans but I will always be within reach of my friends and well wishers.

MARTIN I. COWEN

My son, ROBERT C. COWEN is remaining with "Consolidated" as Sales Engineer and is at your service at all times.

POSITIONS WANTED
(Continued from proceding page)

CHEMICAL ENGINEER, 32, graduate, C.I.ch. E., registered PE—Eleven years supervisory experience in project engineering, process design, plant startup, operation and maintenance of chemical and vegetable oil plants. Broad background in process evaluation and report writing with proven ability for handling men. Limited experience in estimating, construction and sales. Seeking responsible and challenging position where exceptional engineering ability, diversified and practical experience are requisites. PW-6115, Chemical Engineering.

INSTRUMENT ENGINEER desires position in process industry. 8 years experience on Pneumatic, Mechanical, Electrical inst. Supervised repair Department. PW-5959, Chemical Engineering.

SELLING OPPORTUNITIES WANTED

AGGRESSIVE. FINANCIALLY responsible salesman seeks one or more accounts NY-NJ Area. B.Ch.E. 1939. Resume — references. RA-5378, Chemical Engineering.

MANUFACTURER'S REPRESENTATIVE, Chemical Engineer, 15 years industrial experience, now covering Michigan, Ohio and Indiana, will accept one or two additional lines. RA-5968, Chemical Engineering.

REPRESENTATION WANTED: Well established Manufacturers' Selling Agency desires additional equipment applicable to petroleum refineries, chemical, industrial and power plants for Metropolitan New York district. RA-5416, Chemical Engineering.

SALES ENGINEERING organization with established following in chemical, Pharmaceutical and allied industries, desires to represent additional processing equipment manufacturers in New York, New Jersey, Delaware and Pennsylvania. Commission only. RA-4452, Chemical Engineering.

MANUFACTURERS' AGENT now handling prominent manufacturer's crushing, grinding, separating and mixing equipment. Desirous of expanding with allied or related line serving the chemical process industries in all or part of Atlantic seaboard. RA-6164, Chemical Engineering.

DO YOU NEED TOP LEVEL REPRESENTATION IN THE WEST

We are now contacting top management, executive engineers and purchasing agents of all refineries, chemical manufacturers and processers, food packers, brewers and bottlers, rock product and metallic and non-metallic mineral mills, atomic energy and government groups. These groups have been contacted regularly for over 25 years, 11 states coverage. If you have equipment or services to sell and need these contacts, for full information, write:

H. L. HEAKIN CO., INC.
1007 GOUGH STREET
SAN FRANCISCO, CALIFORNIA

CHEMICAL PLANT
FOR SALE OR RENT

Complete Chemical Plant in New Jersey, 2500 gal. steel reactor, 15 HP package boiler, 350 gallon steel autoclave, filter press, pumps, etc. In operable condition.

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CUSTOM REFINING FACILITIES
- Distillation • Extractions
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WANTED
- All Types of Crude Mixtures
- By-Products, Residues, Wastes
- Contaminated Solvents

TRULAND CHEMICAL & ENGINEERING CO., INC.
Box 426, Union, N. J. UNionville 2-7360

WANTED

CHEMICAL PLANT
WANTED

We are now manufacturing over $20,000,000 in various lines and wish to expand by acquisition of assets or stock of one or more industrial companies. In our negotiations the sellers' problems and wishes will receive full consideration. Present personnel will normally be retained.

Address all replies

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WANTED
Vertical Autoclaves

Four 125 lb. square inch WP Vertical Autoclaves, jacketed, agitated, steel, glass lined, or stainless maximum diameter of jacket 8'-0".
Capacity—2500 gallon min. to 4000 gallon max.

W-5965, Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

WANTED

Vacuum Dryers, Heavy Duty Mixers, Reactors, Kettles, Columns, Rotary Filter, Pulverizers, Filter Presses, S/S and non-corrosive Tankage. Idle or Set Up Plant.

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Dyes - Chemicals - Pigments - Waxes
Plasticizers - Solvents - Colors
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FOR OUR 36th YEAR, we extend our HEARTIEST GREETINGS to the CHEMICAL and PROCESS INDUSTRY

THE KEY TO SAVING TIME AND MONEY
CONSOLIDATED
PRODUCTS COMPANY, INC.

ROTARY KILNS & DRYERS

3—Vulcan Iron Works 6'x60, complete, each with 3'x50' Rotary Cooler.
1—7'x45' Link Belt Kiln, complete.
1—7'6"x125'; 1—8'x135' Allis Chalmers Rotary Kilns.
4—Ruggles-Coles Direct Heat Rotary Dryers—Class XF4—54"x25', 1 Class XF 5'x40'. Also L-B 27"x10' Roto Louvre; three 3'x50'; 5'x30'; 5'x50'; 6'x40'; 6'x60'; 7'x70'.
3—6'x50' Louisville Rotary Steam Tube.
1—4'x6' Flaker or Cooling Roll.
1—5'x33' Rotary Vacuum Dryer, jacketed shell; 1—20"x8', jacketed, with dust collector and condenser.

DRY POWDER MIXERS

1—Kilby jacketed Horiz. Ribbon Mixer, 450 cu. ft. capacity.
1—Howes 3,000#, double ribbon.
1—Day Size F, 1850#; 1—Howes 1,800# dbl. ribbon; 1—Munson Rotary 1,000# batch; 1—Day 400#.

EVAPORATORS

1—Quadruple Effect Evaporator, calandria type, brass tubes, 14,000 sq. ft. H.S.; excellent condition; still erected; complete with piping, etc.
4—Mojonnier S/S Vac. Pans, 3', 4', 5', 6'.

HIGH SPEED MILLS

8—J. H. Day type B, 14" x 30" 3 roll High Speed Roller Mills, with all roller bearings and watercooled rolls—silent chain drive.
1—Ross 9" x 24" 3 roll High Speed Roller Mill, Model 52, roller bearings, self contained 10 H.P. motor.

FILTER EQUIPMENT

2—#12 Sweetland Filters for 36 leaves on 4" c.c.
10—Shriver 42"x42", Iron Filter Presses, Plate & Frame, 18, 27, 36, 54 chambers, 1" cake.
16—Sperry 18'x18', Iron, P & F, Filter Presses, closed delivery, 11 chambers.
1—American Disc Filter 6' dia., 2 disc, 100 sq. ft. filtering area, with auxiliaries.
1—Shriver, iron, steam heated, 30"x30", 20 chambers, 1" cake.
1—8'x12' Oliver Lead-Wood Vacuum Filter Acid-Resisting.
3—Oliver Vacuum Filters, incl. 8x12', 11'6"x14', 11'6"x18'.
1—ALUMINUM Sperry FILTER PRESS, 30 x30", 45 chambers, 1" cake.
1—Sperry, 24"x24" P & F Filter Press with 2[illegible] chambers, 2" frames.
1—#7 Sweetland Filter with 20 steel leaves, 4" c.c., NEW 1951.

BAKER PERKINS MIXERS

4—3000 gallon, size 30, type X-BS, welded.

SPECIALLY PRICED FOR QUICK REMOVAL

6—Devine #28 Vacuum Shelf Dryers, each 20 shelves 59" x 78", surface condensers and vacuum pumps.
2—Ball & Jewell #2 Rotary Cutters.
1—Tolhurst 48" steel basket Centrifugal, suspended type, bottom discharge.
4—Traylor Tube Mills, 5' x 22', 5' x 20', 4'6" x 18'6", 4' x 13', each stone-lined, scoop feed, pebble charge, clutch pulley.
Still installed in one plant as operated, with all accessories as used.

VIBRATING SCREENS

1—Tyler Hummer 4'x10', 2 deck, with 2 vibrators.
1—Battery of two 3'x5' Tyler Hummer, Type 33, with Generator Set for both.
1—3'x8' Selectro, single deck.
1—3'x6' Selectro, single deck.
1—3'x6' Selectro, double deck—rebuilt.
1—18"x5' Selectro—rebuilt.
1—Day S/S single deck, 40"x84".
1—Tyler "Rotap" Testing Screen AC motor.

PEBBLE MILLS

All porcelain lined

3—5' x 4', 235 gal.
2—6' x 8', 800 gal., porcelain and burrstone lined.
1—Abbe #4 porcelain lined, 125 gal., 45" x 42".
1—Patterson 24 x 36", 25 gal.

DOUBLE DRUM DRYERS

1—42" x 120" Buflovak Atmospheric S/S Conveyors, S/S Elevator, S/S Hood.
4—5' x 12' Buflovak Atmospheric.
2—32" x 90" Buflovak Atmospheric.
1—32" x 72" Buflovak Atmospheric.

IDLE MACHINERY?
WE BUY FOR CASH
SEND LIST

PULVERIZERS

1—#5057 Raymond 5-roll, high side, with oil journals. Complete.
3—#5047 Raymond High Side, 4 rolls, one with "whizzer" air classifier and oil journals; mill equipped with Raymond exhausters, cyclones and piping, 2—50 HP 3/60/2200 volt motors with ea. of two mills.
1—4'6x7' Ball Mill, Allis Chalmers, iron lined. Used 100 hours.
3—Mikro Pulverizers, 2SI, 4TH.
1—8"x15" Sturt. Jaw Crusher, to ½".
1—24"x15" Sturtevant Crushing Rolls, balanced type.

JACKETED KETTLES

2—500 gal. steel jacketed closed agitated Vacuum Reactors.
8—Dopp C.I. 80, 100, 150, 350, 600 gal.
7—Steel, agitated, 350, 500, 700, 800.
2—700 gal. closed, with Simplex Turbo Mixers, reduction drive, m.d.
3—9500 gal., welded, agitated, open.
29—Aluminum and Copper, 30 gal. to 600 gal., some agitated.

NEW STAINLESS STEEL FABRICATION

We have available excellent facilities for fabricating Stainless Steel Tanks, Kettles, Condensers, Reactors, Autoclaves, Distillation Columns, Filter Presses, Heat Exchangers, etc.
ASME Code Construction
Will gladly furnish estimates to your specifications.

MISCELLANEOUS

1—42" Stainless Steel A.T.&M. Co. Centrifugal, 40 H.P. Motor.
1—Tolhurst 40" monel Centrifugal.
1—13,500 gal. Stainless Steel Tank, closed, agitated, S/S coils, m.d.
5—Labour S/S pumps, 5 & 10 H.P.
2—Buflovak 6' dia. Vacuum Crystallizers; 1—6' dia. Atmospheric, jacketed.
1—6'x14' Hardinge Rotary Counter Current Classifier, also for dewatering or scrubbing.
2—Dorr two-stage Classifiers, each with two rakes, total length 27', gear reducer and motor.
1—Davenport #3A Dewaterer, with speed reducer and 5 HP AC motor.
1—Mechanical Cooker, 8' diag. x 18 long, jacketed, agitated, Insur. Certificate.

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LARGEST AND OLDEST DEALER IN REBUILT PROCESSING EQUIPMENT

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DON'T "PINE" FOR VALUES

BUY GELB

ALWAYS THE SAME

HIGH QUALITY

1—Banbury Size B Laboratory Mixer with Motor & Reducer.
12—Simpson #0 Intensive Mixers "Unused".
1—Readco Stainless Steel Jacketed Double Arm Jacketed Mixer, Sigma Blades, 225 Gals.
1—Buflovak Stainless Steel Rotary Vacuum Dryer, 3' x 15'.
1—Baker Perkins Stainless Steel Dispersion Mixer, Size 15, Type VUMM, 100 gals. working cap., 150 gals. total cap., 75 HP Drive.
1—Baker Perkins Stainless Steel Jacketed Lab. Mixer, Size 4, with 2 HP Exp. Proof Motor, 0.7 gals. cap. Sigma Blades.
1—Patterson Stainless Steel Autoclave, 225 gals. cap. with stainless steel turbo agitator, 225 PSI internal pressure.
1—Glascote glass lined jack. vac. reactor, 1600 gals. cap. (Unused).
1—Combustion Engineer Stainless Steel jacketed autoclave, 500 gal. cap., 300 PSI internal pressure.
1—Struthers Wells Hastelloy B Heat Exchanger, 450 sq. ft.

THE GELB GIRL—DECEMBER 1952

DRYERS—KILNS

1—Louisville Rotary Steam Tube Dryer, 6'x50'.
1—Huhn Rotary Steam Tube Dryer, 3'x12'.
2—Buflovak Vacuum Drum Dryers, 24"x20".
2—Buflovak stainless steel double drum dryers, 6"x8", vacuum and atmospheric.
1—Buflovak Double Drum Dryer, 32"x90".
20—J. P. Devine Lab. Vacuum Shelf Dryers, 5 shelves.
1—J. P. Devine Rotary Vacuum Dryer, 5'x25'.
2—J. P. Devine Vacuum Shelf Dryers, 9 shelves.
1—F. J. Stokes Vacuum Shelf Dryer, Model #138-13, 12 shelves.
2—Buflovak Double Door Vacuum Shelf Dryers, 20 shelves each.

FILTERS

3—Shriver 24"x24" Aluminum Plate & Frame Filter Presses, Closed Delivery, 35 Chambers each.
1—Sperry 42"x42" Aluminum Plate & Frame Filter Press, 3" Frames, Closed Delivery, 35 Chambers "Unused".
1—Sperry 42"x42" Cast Iron Plate & Frame Filter Press, 16 Chambers, Closed Delivery.
1—Sperry 12" Bronze Plate & Frame Filter Press, Closed Delivery, 9 Chambers.
1—Shriver 42"x42" Evedur (Bronze) Plate & Frame Filter Press, 40 Chambers. Closed Delivery.
1—Shriver 36"x36" Cast Iron Plate & Frame Filter Press. Steam Jacketed, 48 Chambers, Closed Delivery.
3—Shriver 36"x36" Cast Iron Plate & Frame Filter Presses, Closed Delivery, 24 & 25 Chambers.
4—Sperry 12"x12" Cast Iron Plate & Frame Filter Presses, 12 and 20 Chambers.
5—Sweetland Filters, #2, 5, 7 and 12.
2—Oliver Rotary Vacuum Filters, 5'3"x6', steel construction with monel screens.
1—Oliver Rotary Steel Filter 3'x1'.
2—Shriver 24"x24" cast iron, closed delivery, filter presses, 3 eye, 23 chambers each.

CENTRIFUGALS

2—A. T. & M. Stainless Steel Suspended Type Centrifuges, 48" Imperforated Baskets with motors.
1—A. T. & M. Stainless Steel Suspended Type Centrifuge, 54" Imperforated Basket with motors.
2—Fletcher 40" Whirlwind Centrifuges, Bronze Perforated Basket with Explosion Proof Motors.
1—Tolhurst Stainless Steel Suspended Type Centrifuge, 40" Imperforated Basket.
1—Fletcher 48" Whirlwind Centrifuge, Bronze Perforated Basket with Explosion Proof Motor.
1—Tolhurst Center Slung Centrifuge, 36" Perforated Steel Basket with Explosion Proof Motor.
1—Sharples Stainless Steel Super D Canter, Model PN-14.
6—Sharples #16-Y Stainless Steel Super Clarifying Centrifuges.

MIXERS

2—Banbury Mixers #1 and #9.
1—Simpson #1 Intensive Mixer.
4—Baker Perkins Steel Jacketed Mixers, Sigma Blades, 100 Gals.
3—Baker Perkins Stainless Steel Jacketed Mixers, Sigma Blades, 100 Gals.
1—J. H. Day Mogul Vacuum Mixer, Sigma Blades, 2½ Gals.
1—J. H. Day Jacketed Powder Mixer, 5000 lbs. Center Discharge.
3—Turbo Steel Jack. Mixers, 700 Gals. Each.

PULVERIZERS—GRINDERS—MILLS

1—Mikro #3TH Mikro Pulverizer with 30 HP Motor.
1—Mikro #3W Pulverizer.
1—Mikro #2TH Pulverizer, Stainless Steel & Bronze Construction, with Motor.
1—Mikro #1SH Pulverizer with Motor.
1—Ball & Jewell #0 S.S. Rotary Cutter.
2—Ball & Jewell #2 Rotary Cutters.
1—Blaw Knox Air Mill Pulverizer.
1—Mikro Stainless Steel Atomizer #6.
3—Thropp 2-Roll Rubber Mills, 18"x50".
1—Abbe #2 Buhrstone lined Pebble Mill, 5'x4'.
1—Gruendler #24-40 Hammer Mill.
1—Thropp 2-Roll Rubber Mill, 10"x24".

SPECIALS

1—Swanson-Walker type 316 S.S. Crystalizer, 4—10' sections.
1—Buflovak type VRC Double Effect Monel Evaporator 250 sq. ft. each effect.

AUTOCLAVES—KETTLES—TANKS

1—Adamson Steel Vulcanizer 6'x20'.
1—Stainless Steel Storage Tank, 16,000 gals.
2—Blaw Knox Steel Jacketed Autoclaves, 300 & 500 Gals. Cap., Working Pressure 500 Lbs.
1—Patterson Steel Jacketed Autoclave, 900 Gals. Cap., Internal Pressure 120 Lbs.
1—Stainless Steel High Pressure Autoclave, 10 Gals. Cap., 250 Lbs. Internal Pressure.
1—Pfaudler Glass Lined Jacketed Vacuum Reactor, 500 Gals. Cap.
1—Pfaudler Glass Lined Jacketed Kettle with Anchor Type Agitator, 150 Gals.
12—Koven Stainless Steel Jacketed Vacuum Kettles, 380 Gals. Cap.
1—Koven S. S. Storage Tank, 1200 Gals. Cap.
1—Koven Steel Mixing Tank, 1200 Gals. Cap. with Nettco Drive, 10 HP Explosion Proof Motor, Turbin Agitator.
1—Artesian Steel Jacketed Kettle, 1,000 Gals. Cap., with Rake Type Agitator, ASME Code, 50 Lbs. Pressure.
2—J. P. Devine Jacketed Vacuum Reactors, 2,000 Gals. Cap. Each.
3—Buffalo Steel Pressure Tanks, 1,000 & 10,000 Gals. Cap., 100 & 125 PSI, ASME Coded.
2—Steel Storage Tanks, 6,700 Gals. Cap. Each, 80 PSI.
10—Steel Fermenting Tanks, 1300 Gals. Each. with Coils & Agitators, 80 PSI.
25—Steel Storage Tanks, 9,000-17,500 Gals.
1—Steel Rubber Lined Storage Tank, 4,500 Gals. Cap.

MISCELLANEOUS

3—Vulcan all Copper Condensers, 300 & 350 sq. ft.
1—Abbe #2 Master Rotary Cutter.
1—Orville Simpson #41 Rotex Screen.
1—Dayton Dowd Centrifugal Pump, Stainless Steel, Size 1C8, 35 GPM at 40' head, speed 1745 RPM, 2"x1".
1—Worthington Worthite Pump, with 7½ HP Motor.
2—Worthington Antaciron Centrifugal Pumps, Model #3 CU1, 4"x3".
1—Lightning Mixer, Model SAG 1000, 10 HP explosion proof motor.
1—Netco Drive, Model WT 27, with 2 HP Motor, 900 RPM, Ratio 53-1, Shaft RPM 16.15.

Established 1886

R. GELB & SONS, Inc.,

CHEMICAL, RUBBER, OIL, PLASTIC and FOOD PROCESSING MACHINERY

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Cast Your Eyes Over These BRILL Buys!

OUR QUARTER CENTURY OF DISTINGUISHED SERVICE TO INDUSTRY ADDS UP TO GUARANTEED SATISFACTION!

DRYERS—KILNS

2—Vulcan 7' x 160', 7' x 110', 5/8" shell, 2-12" tires, complete.
1—Allis-Chalmers 10' x 90', 9/16" shell, 2-14" tires, complete.
1—Vulcan 8' x 80', 5/8" shell, 2—12" face tires.
1—6' x 60', 3/4" shell, 2-8" tires, complete.
1—Vulcan 4½' x 50', 3/8" shell, 2-6" tires, complete.
2—Link Belt 2'7" x 8' monel, 2'7" x 10' steel, Roto-Louvre Dryers.
6—Rotary Dryers 7' x 70', 7' x 60', 5' x 67', 4'6" x 40', 4' x 25'.
3—Louisville Rotary Steam Tube Dryers 6' x 50', 6' x 30', 3' x 20'.
1—Louisville Rotary Steam Tube Dryer 6' x 27', S.S. tubes.
2—Devine 17 shelf double door vacuum Dryers 59" x 78".
2—Devine 10 and 6 shelf vacuum dryers 40" x 43".
5—Stokes & Buflovak Rotary Vacuum Dryers 30" x 8', 3' x 15', 6'6" x 38'.
5—Buflovak 60" x 144", 42" x 120", 32" x 90" Atmospheric Double Drum.
1—Single Drum 60" x 80" Flaker.
1—14 Truck steam heated Dryer 1680 sq. ft.
1—Pittsburgh Lectro Dryer size X, type CH.

FILTERS

6—Vallez Pressure Filters 360 and 540 sq. ft.
1—Sweetland #12 with 36 leaves.
1—Sweetland #10 with 36 steel leaves.
1—Sweetland #7 with 27 steel leaves.
8—Oliver Rotary Vacuum 11'6" x 14', 8' x 12', 8' x 10', 8' x 8', 5'3" x 6', 3' x 1'.
3—Eimco Rotary Vac. 8' x 8', 4' x 5', 4' x 4'.
1—Oliver 6' x 3' steel Rotary Precoat Filter.
1—Feinc Rotary Vacuum 8' x 12' steel with drive, etc.
3—Shriver 36" P&F, 30 chambers, c.i., closed delivery.
1—Sperry 36" Recessed, 48 chambers, c.i., open delivery.
5—Shriver 30" P&F, 30 chambers, c.i., open delivery.
8—Sperry 24" P&F, 16 chambers, c.i., closed delivery.
1—Shriver 24" Recessed, 30 chambers, c.i., open delivery.
3—Shriver 18" Recessed, 30 chambers, c.i., open delivery.
2—Sperry Aluminum 30" and 24" P&F, 22 and 26 chambers.
10—Shriver, Sperry Filter Press Skeletons 42" to 18".

CENTRIFUGALS

1—Fletcher 48" Suspended Aluminum bottom discharge, perforated basket, motor-driven.
1—Tolhurst 48" center slung, SS perforated basket.
1—AT&M 42" Suspended SS, bottom discharge, perforated.
1—Fletcher 40" Suspended, bottom discharge, SS, perforated basket.
1—Fletcher 40" center slung, rubber covered, perforated basket.
1—Tolhurst 32" Suspended Monel, bottom discharge, perforated.
1—Tolhust 26" suspended Monel, bottom discharge, perforated.
1—Tolhurst 26" suspended, steel, bottom discharge, perforated.
2—Bird 36" x 50" solid bowl, rubber and stainless.
1—Bird 36" x 50 solid bowl, steel.

FOR YOUR SPECIAL CONSIDERATION

SPECIALS

1—Buffalo 10' x 50' A.S.M.E. Steel Tank.
2—Oliver monel 8' x 10' Rotary Vac. Filters.
2—Oliver 5'3" x 3' Rotary Vacuum Enclosed Precoat Filters.
1—Rogers Spray Dryer 16' dia. with all accessories.
2—Pfaudler 100 gal. glass-lined Stills with Condensers.
3—Steel 2000 gal. jacketed, agitated, 200 PSI Reactors.
1—Pfaudler 350 gal. glass-lined, jacketed, agitated Reactor.
3—Dopp 250, 150 gal. jacketed, agitated Kettles.
3—Rotex #42 Double Deck Screens 40" x 84".
1—Buflovak VRC, S.S. Single Effect Evaporator 94 sq. ft.
1—Swenson Quadruple Effect Evaporator S.S. 2600 sq. ft.
1—Buflovak 6' dia. Vacuum Crystallizer.
1—Hardinge 4½' x 16" Conical steel-lined Ball Mill 30 HP motor.
1—Vertical Storage Tank 30' dia. 26' high, 135,000 gal.
1—Bird 18" x 28" steel solid bowl Centrifugals.
2—Sharples #16-P Monel Pressuretite Centrifuges.

Seasons Greetings

PULVERIZERS

2—Raymond 4 roll High Side Mills, complete.
5—Al. Ch. 6' x 22' steel lined Tube Mills.
4—Prater Mills, type G5S with screen discharge.
1—American Pulverizer Company 24" x 24" Ring Crusher.
1—Bauer 36" Attrition Mill 2-50 HP motors.
17—Patterson, Abbe Pebble & Ball Mills 60 to 1000 gals.
2—Premier Colloid Mills 8" dia., S.S.
1—Eppenbach QV7 Colloid Mill.
2—Jeffrey 36" x 24", 20" x 12" Hammer Mills.
3—Raymond, Gayco Mechanical Separators 14', 12', 4'.
1—2 Roll Rubber Mill 6" x 12".
2—Mikro No. 1SI, No. 1SH Pulverizers.
1—Fitzpatrick Comminuting Mill 7½ HP.

SCREENS

1—Selectro S.S. double deck 4' x 10'.
5—Sprout Waldron S.S. sgle. deck, 40" x 84".
1—Robinson Triple Deck 40" x 104".
4—Tyler Hummer 3' x 15', 3' x 10', 4' x 7' Single Deck.
5—Tyler Hummer 3' x 5' Triple Deck.
1—Abbe #2 Blutergess Sifter.

MIXERS—ALL TYPES

4—Baker Perkins 200, 100, and 50 gallon, jacketed, double arm, sigma blades
1—Baker Perkins 300 gal. Unidor S.S.
1—Baker Perkins ½ gal., jacketed.
1—Baker Perkins, type JNM, 100 gal., jacketed, double arm.
1—Day 30 gal. Imperial jack. double arm.
10—Rodgers 200 to 3000# Powder Mixers.
12—Electric, Port. Agitators ¼ to 5 HP, NEW.
4—Day, Ross, 8 and 50 gal. Pony Mixers.

MISCELLANEOUS

1—Peabody Gas Scrubber 25000 CFM at 500° F.
1—Brown Hoist steam Locomotive Crane, 25 ton capacity, 40' boom.
3—Butler Auto. hopper scale, barrel fillers.
1—Redler 7" Conveyor unit, 100' centers.
20—Bucket Elevators, steel housing, 34' to 90' centers, 8" x 5" to 24" x 8" buckets.
7—Stokes Vacuum Pumps 15 to 100 CFM.
1—Milton Roy Proportioneer Pump, S.S. and Hastelloy, 10 GPM.
5—Devine, Buflovak, Condensers and Receivers, 20 to 90 sq. ft.
7—Groen 150, 125 gal., S.S., jacketed, agitated, kettles.
4—Stokes DD2, D4 Rotary Tablet Machines.
5—38" dia. Stainless Steel Revolving Pans.
2—Nash #4, AL671 Vacuum Pumps.
10—Olivite, Duriron, Rubber, Durimet and Haveg Centrifugal Pumps 6" to 4".

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FOR SALE—WE OWN IT OR CONTROL IT!

COLUMNS—STILLS

2 Aluminum Bubble Cap Columns, 36" dia. x 45 plate.
1 Aluminum Bubble Cap Column, 27" dia. x 18 plate.
1 Aluminum Perforated Plate Column, 28" dia. x 36" plate.
1 Copper Column with 18—30" dia. perforated plates and 10—24" dia. bubble cap plates.
1 Copper Sieve Plate Column, 30" dia. x 22 plate.
1 Copper Perforated Plate Column 24" dia. x 14 plate.
1 Steel and Cast Iron Bubble Cap Column, 30" dia. x 62 plate.
1 Stainless Steel T316 Raschig Ring packed column, 24" dia. x 6'8" high.
1 Stainless Steel T316 direct fired Vacuum Still, 325 gal.

CONDENSERS—EXCHANGERS

3 Aluminum tub. 166 sq. ft.
16 Alum. Coil Exch. 96 sq. ft.
5 Copper tub. 65, 95, 140, and 725 sq. ft.
3 Stainless Steel tub. 8½, 39, 330 & 400 sq. ft.
3 Stainless Steel Coil Condensers, 40 sq. ft., 60# pr.

DRYERS—EVAPORATORS

1 Stokes #59A Jacketed Vacuum Rotary Dryer, 18" dia. x 42" long.
2 Atm. Double Drum Dryers, 22" x 38".
1 Cummer Rotary Hot Air Dryer, 46" dia. x 28' long.
1 Struthers Wells Evaporator, 100 sq. ft. tube bundle.

FILTERS

1 Sweetland #5, 30 lvs.
1 Sweetland #12, 72 lvs.

1 Swenson Rotary Continuous Vacuum Filter; Precoat type, 8' dia. x 8' face, rubber covered and lead acid proof construction.
1 FEINC Rotary Vacuum Filter, string discharge, 4'6" dia. x 6' face, aluminum.

1 Ertel Bronze Disc Filter, 90 sq. ft.
4 Pressure Leaf Filters, 70 to 90 sq. ft.
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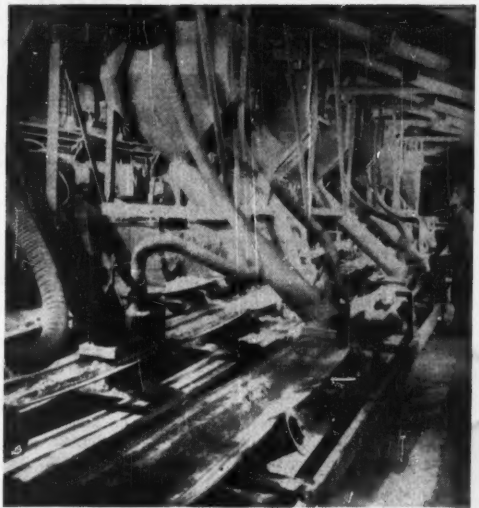

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San Francisco......Ralph Dorland

SEARCHLIGHT SECTION
(Classified Advertising)
H. E. Hilty, Mgr.

Chemical Engineering Reader Service

CHEMICALS – EQUIPMENT – SERVICES

What Reader Service Does for You

This department can serve you in two ways. It is a complete classified directory to equipment, chemicals and services offered in this issue of Chemical Engineering. It is also a key to the Reader Service postcard (inside back cover) that will bring you free additional information on any of the listed items.

How Reader Service Works

The Reader Service postcard inside the back cover makes it easy to get more information on any of the chemicals, equipment or services listed here. The card has corresponding numbers for each of the key page numbers in this directory. Circle the numbers of the items you want; fill out the return address; mail the card to us. Answers will come direct to you from the companies. The letters, L, R, T, B, locate ads on the page: left, right, top, bottom. The letters a, b, c and A, B, C indicate first, second, third, etc., item in an ad or on a particular page.

CHEMICALS

EQUIPMENT

SERVICES

Use This Handy Postcard to Help You in Keeping Up-to-Date

Circle numbers of desired items, fill in reverse side, tear out and mail

CHEMICAL ENGINEERING: Send me more information about . . . (Card expires March 1.)

. . . Items in this Reader Service section as circled below:

2a	28-29	61	89	127	210F	222A	234B	256	291	312	337	358F	359N	360U	B370	394	TL433	445	464
2b	30	62	90	128-129a	211a	222B	235	257	292	313	T338	358G	359O	361	371	395	BL433a	446	TL465a
4-5	31	63	91	128-129b	211b	222C	236	261	293	314	B338	358H	359P	362	T372a	396	BL433b	L447	TL465b
6	32-33	64	92	128-129c	211c	222D	236A	T263	294	315	339	358I	359Q	362A	T372b	397	R433	R447	BL465
7	34a	65	93	128-129d	212A	222E	236B	B263	295	316	340	358J	359R	362B	B372	398	TL434	448	R465a
8	34b	66-67	94-95	131	212B	222F	236C	265	296	317	341	358K	359S	362C	373	400	BL434a	L449	R465b
9	35-36a	68	96	132-133	212C	222G	236D	266	297	318	342	358L	359T	362D	T374	401	BL434b	R449a	R465c
11	35-36b	69	97	134	212D	223	236E	267	T298	319	T343	358M	359U	362E	B374	402	BL434c	R449b	R465d
12	35-36c	70	98	135	212E	224A	237	268	B298	320	B343	358N	360	362F	375	403a	R434	R449c	466
13	37	71	99	136-137	213	224B	238	269	299	321	T344	358O	360A	362G	377	403b	435	TL450	467
14	38	72	100a	138	214A	224C	238A	270	300	322	B344	358P	360B	362H	378a	403c	TL436	BL450	468
15	39	73	100b	139	214B	224D	238B	271a	301	323	345	358Q	360C	362I	378b	404	BL436	R450	469
16	40	74	100c	140	214C	224E	238C	271b	302a	325	346	358R	360D	362J	378c	405	R436	451	470
17	41	75	100d	142a	214D	224F	238D	273	302b	T326	347	358S	360E	362K	378d	406	437	452a	471
18	42-43	76	101	142b	214E	225	238E	274	302c	B326	348a	358T	360F	362L	378e	423	438	452b	472
19a	44	77a	102	142c	214F	226	239a	T275	302d	327	348b	359	360G	362M	379	424	439	453	473
19b	45	77b	105	142d	214G	226A	239b	B275	302e	328	349	359A	360H	362N	380	L425	440	454	TL474
20-21	46-47	78-79	106-107	142e	215	226B	239c	276a	302f	329a	350-351	359B	360I	362O	381	R425	TL441	455	BL474
22-23a	48	80a	109	142f	216	227	239d	276b	303	329b	352	359C	360J	362P	382	TL426	BL441	456-457	R474
22-23b	49	80b	111	142g	216A	228A	244	276c	T304	329c	354	359D	360K	362Q	383a	BL426	R441	458	475
24-25a	50	80c	112-113	142h	216B	230A	245	276d	B304	329d	355	359E	360L	362R	383b	R426	L442	459	476
24-25b	51a	81a	114-115	207	217	230B	246	277	305	T330	356	359F	360M	363	385	427a	TR442	460	477
24-25c	51b	81b	116-117	208A	218A	231A	249	279	306-307a	B330	357	359G	360N	364-365	387	427b	BR442a	461a	TL478
24-25d	52	81c	118	209A	218B	231B	251	281	306-307b	331	358	359H	360O	366a	388	428	BR442b	461b	BL478
24-25e	53	82	119	208B	218C	231C	253	283	306-307c	332	358A	359I	360P	366b	389	429	BR442c	461c	R478
24-25f	54	83	120	210A	219	232A	T254	285	306-307d	333a	358B	359J	360Q	T368	390	L430	443	461d	479
24-25g	55	84	121	210B	220	233	B254	287	309	333b	358C	359K	360R	B368	391	R430	L443	461e	481
24-25h	56	85	124	210C	220A	234	T255	288	310	335	358D	359L	360S	369	392	431	TR444	462	499
26	57	86-87	125	210D	220B	234A	B255	289	311	336	358E	359M	360T	T370	393	432	BR444	463	500
27	58-59	88	126	210E	221														

. . . Send me these reprints, I will remit on receipt. (See other side of this card for descriptions.)

1	2	3	4	6	8	9	15	18	22	23	24	25	26	27	28